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AMERICAN ENGINEERING IN EUROPE.

It is a very gratifying fact that in London, which is perhaps the most conservative city on the face of the earth, a great new undertaking in urban transit has been begun, using American methods and American machinery. The Central London Underground Railroad, which is fully described in this issue, will be one of the most important installations ever laid down. That those in charge should have chosen American apparatus throughout is cause for congratulation, not only to the makers of the apparatus and American engineers generally, but also to the corporation that will use it.

Only a few weeks ago an important overhead trolley line was opened in Belgium, and on this, again, only American methods and apparatus were used. It seems that at last we are beginning to be appreciated on the other side, and that a new field for the exploitation of our manufactures is being rapidly opened.

The inertia of municipal bodies in England has been responsible for much of the delay in the introduction of approved methods of rapid transit in the towns and cities of Great Britain. Under ordinary circumstances and with no undue delay, it takes anywhere from two to three years to obtain a concession or franchise for the construction of a street railway in an English city. The restrictions which are placed upon engineering enterprises of all kinds by various authorized officers in foreign cities, while probably productive in the end of public safety and certainly dictated by a regard for the general welfare, are at times very trying and annoying. These are some of the reasons why to-day this country is so much further advanced than any other in the practical application of the electric arts. The contrast with Great Britain is especially noticeable.

Now that the English cities are beginning to feel the vivifying impulse that comes from good transit facilities, a great and practically unworked field is open for the American inventor, engineer and manufacturer. The vast experience that has been gained in this country in the construction of all kinds of street and interurban electric railways makes us beyond question the leading manufacturers of such systems. The English are beginning to see that they need the benefit of our methods, our machinery, and our experience. It seems that this furnishes a most excellent occasion for all-round felicitation. It is certainly a pleasant thing to know that the main artery of the great transit system of London is thoroughly and entirely American.

THE DETROIT MEETING OF THE A. A. A. S.

The programme of the Detroit meeting of the American Association for the Advancement of Science, which has just been issued, and of which a portion is republished in another column, presents an exceedingly attractive and interesting collection of papers and subjects for discussion. The great American universities are all represented in the list of authors.

It is likely that this will be one of the most important and satisfactory meetings that this body has ever held. The British asso-

ciation meets on August 18, at Toronto, and many of its members have signified their intention of being present at Detroit and taking part in the proceedings of the meeting of the American association. The programme is particularly strong in electrical papers, and the well-known reputation of many of the authors will doubtless secure a large attendance at the meeting.

AN ANNIVERSARY.

It is hard to believe that it is only ten years since the first electric railway was put in commercial and satisfactory operation. Some time in the month of July, ten years ago, the first cars of the Richmond, Va., road were put in motion.

No one who saw the almost experimental road of those days or the gigantic difficulties under which the earlier engineers worked, could have had the hardihood to predict that within ten years the industry of electric traction should have developed to its present proportions. In the short time between then and now the problems have been solved, the difficulties have been overcome, and designs have been produced which, for the perfect and satisfactory adaptation of all their parts to the uses imposed upon them, leave nothing to be desired. The electric street railway of to-day is practically perfect, and further improvements in it cannot be radical, but must be confined to matters of small detail.

Those who have been engaged in this work have had little time to stop and think of how wonderful the growth of this industry has been. This season of the year is the time when all good Americans plume themselves. There is nothing that has ever been done in the way of the development and establishment of an art quite so worthy of pride as the marvelous growth of the electric railroad in America. It is a distinctively American institution, and as such we should all feel proud of it and of its growth at the end of its tenth year.

RÖNTGEN RAY SPECULATIONS.

Prof. Elihu Thomson's bold and original speculation regarding the cause of Röntgen rays, which was printed in our last issue, opens the way for a wonderful exercise of the scientific imagination and is full of alluring suggestion to the experimenter. It may be that we now stand upon the verge of the great discovery so long foreshadowed, and that the secret of the complex nature of many, if not all, of the so-called elements will soon be revealed.

The modes of vibratory motion indicated by the complex spectra of the great majority of the elements are so bewildering and confusing that the mind recoils before the task of attempting to picture the structure of their molecules. Recent research in the regions on both sides of the visible spectrum has extended the spectra of certain elements, dimly shadowing in some cases a more or less complicated harmonic law, connecting the various vibration periods of a single molecule. These facts taken in connection with the singular grouping of the elements in series determined by their molecular weights and physical properties, indicate kinships between them and structures of such amazing complexity that belief in their simple and elementary nature is almost impossible. As yet, however, no element has been separated into its parts.

Professor Thomson points out a fact which is generally overlooked. There is no assignable upper limit to possible temperatures. So far, the best means for producing high temperatures have resulted only in moderate degrees, compared, for example, with the observed temperature of the solar photosphere. It does not, therefore, seem unreasonable to believe that some of the elements at least, under heats greater than those to which we have been able as yet to subject them, would dissociate and show their complex nature. The absence of several of the most common telluric elements from the sun is a circumstance which lends additional probability to this idea.

If Röntgen rays differ from other forms of radiant energy only in the matter of wave length, the almost inconceivable shortness of the vibration period assumed would seemingly necessitate a very high temperature for their production. The task of the experimenter who will solve the intricate problems connected with the genesis of these rays is by no means easy. It seems probable now that this elusive radiation which defies the spectroscope may give to the investigator whose patience and skill are sufficient the richest reward that science has bestowed for centuries.

ELECTRIC LIGHTING IN ENGLAND.

In another column is an article by Messrs. Lomas and Gunton, describing the electric lighting plant at Bolton, England. This station is a fairly typical representative of English alternating-current supply stations, and possesses much interest on that account.

Like many other English stations, the plant at Bolton is owned by the municipality. This arrangement seems to operate in a more satisfactory way abroad than in this country, if its popularity may be judged by the number of plants so owned. The prices charged for current at Bolton seem reasonable, while the station was evidently carefully designed.

A noticeable fact is the intention of the management of this plant to increase its capacity by the use of high-voltage lamps instead of increasing the conducting system. That this should be done, even though it entails the rewinding of many transformers and the change of many small fittings, shows how firmly the belief in the superiority of high-pressure lamps has become grounded in England. There are few lessons for us to learn by the study of English installations, but this plant embodies at least two features of great merit—the use of high-voltage lamps and the method of charging for current—which compel attention.

There is no doubt that American stations have paid too little attention to the all-important question of methods of charging for current. Those who have the old contract and flat rate systems still in vogue can learn much by studying the methods in use in many of the compact, well-managed, and dividend-paying installations in Great Britain.

The Shoreditch Refuse-Destructor Plant.

On the afternoon of June 28 Lord Kelvin opened the municipal electrical works at Shoreditch, England, which were designed to utilize refuse from the vicinity of the station for the generation of electric current and to combine therewith a system of hot water storage, supplying water to public baths and laundries. In opening the works, Lord Kelvin described the general operation of the plant and placed particular stress upon the happy combination of scientific principles, saying that it required particular courage to install this initial plant. The refuse will be carted to the works, where it will be distributed by motor cars and electric hoists to tipping platforms, from which it will be shot by the aid of mechanical feeders into the furnaces beneath the boilers. Forced draughts produced by motor-driven fans will be used. These fans will also exhaust the gases from the adjoining sewer and blow them into the furnace fires. A system of thermal storage is to be combined with the plant. It is expected that nearly 20,000 tons of refuse, which has in the past been carried to barges and then dumped into the sea at great expense, will be consumed annually in this plant.

Electricity on the Stage.

BY H. BISSING.

When we consider the wonderful advance in the practical applications of electricity during the past few years it is surprising to note the little progress in the application of electricity to the stage. Some few individual effects, such as water ripples, volcanic eruptions, etc., show considerable inventive genius, but in the use of the arc lamp for light alone we are practically not advanced over its original conception. Most electricians of traveling companies have tested the automatic lamps of the various makers for one season and then have returned to the primitive hand-feed lamp.

For stationary use the automatic lamp has been most successfully used, but for traveling purposes the hand-feed is the only truly reliable form. This lamp usually consists of a main gear wheel meshing two rods of different pitched racks, so that the top carbon is fed down faster than the lower carbon is fed up; by this arrangement the arc remains in practically the same position on direct-current circuits. An improved form of lamp is composed of two rods for the positive carbon, one having the same pitch as the lower carbon rod, and the other having a greater pitch. On alternating-current circuits the first and third are thrown in by releasing a pin and both carbons feed the same. On direct circuits the second and third are thrown together, and the positive carbon feeds faster than the negative.

The two great objections which have been rightfully urged against the use of "electro-calciums," as they are very erroneously called, are the unsteadiness of the light on any but almost absolutely constant-potential direct-current circuits, and the cold, intense whiteness of the light.

The former objection can be avoided to a great extent by using large-sized german silver resistance in the circuit in place of small iron wire, employing skilled operators, keeping the contact points perfectly clean and drawing a small arc. In many towns, however, outside of the larger cities, it is necessary to use a 200 to 250-volt motor circuit, on which there is a constantly varying load, accompanied as a rule by a 10 to 25 per cent. drop in voltage. In such places as this it is almost impossible to prevent flickering. Then, again, it is not always possible to get skilled operators who can prevent the carbons from freezing or hissing. On large 115-volt lighting circuits using direct current with feed wires well within safe carrying capacity, it is quite possible to overcome this objection almost entirely.

Such is the fate of man, however, that when we are on such a circuit and in the words of the vernacular are "getting light," the artistic stage director complains of the brutal whiteness of the light, or draws his coat tightly about his neck, insisting that the light is cold enough (no matter how much the poor operator is perspiring) to give him a chill; or maybe he will burst forth in all his wrath and cry: "Put out that —— lamp and give me a calcium."

It is impossible to obtain with an electric arc the same mellow light which has kept the gas calcium so long in use. It seems that no matter how much we reduce the light by means of milk glass and gelatine mediums, we cannot reach the ideal set by the gas calcium. This was made strikingly apparent by the change in appearance of that beautiful piece of stage lighting, the ruin scene in Miss Davenport's production of Sardou's "Gismonda." Lighted by gas calciums this scene was a triumph; lighted by electric arc, in charge of an excellent electrician, it was a mediocre success. The writer has spent several years experimenting to obtain a mellow light from the arc, with more or less success, and it is his belief that by varying the voltage and the composition of the carbons used, results can be obtained equal to the gas calcium.

At the present day the importance of the employment of a high-grade carbon cannot be emphasized too strongly. It has been the prevailing custom for theatrical electricians to use a very soft carbon. This is a mistake, as much of the flickering and hissing of lamps can be traced to a use of very soft carbons. It is not a difficult matter to select a proper carbon, as any cored carbon of foreign make will answer the purpose.

The great bugbear of the arc lamp for stage use is alternating current. The light emitted has a pale blue cast and the hum accompanying that light is anything but pleasant for pathetic scenes or solos. By using a bank of resistance of german silver wire instead of an individual coil at each lamp, wound in coils and hung upon an iron frame well covered with asbestos, avoiding porcelain altogether, this hum has been reduced to a minimum, and almost entirely annulled.

The great objection to alternating current is that we cannot get near the amount of light in a given direction with the same ampere flow as with direct current. While this may seem paradoxical at first blush, it nevertheless admits of a simple explanation. When using direct current it has been the custom, in order to throw the light down on the stage, to feed the positive pole to the top carbon and the negative to the lower carbon, at the same time having the lower carbon solid, two sizes smaller than the positive carbon, and staggered about one-quarter of an inch to the front. By these means we draw the crater of the arc to the side of the top carbon and can focus it in any given direction, while at the same time the lower carbon being smaller gets practically white hot, and also being smaller it obstructs few of the rays from the positive carbon.

With alternating currents we must burn the same-sized carbon top and bottom, and we must keep one carbon directly under the other to prevent hissing and flaming of the arc. Most alternating low-potential systems are run at 50 volts, and there are still many station superintendents who have yet to find out that the secondaries of similar transformers can be seriesed for 100 volts; it becomes necessary for the electrician to cut out his resistance and greatly increase the hum of his lamp.

The writer has been asked upon numerous occasions to give his idea of the best system for traveling use, and he has always advocated the "bank of coils" in preference to the "individual coil."

The former system is to be preferred to the latter in the first place because all fuse blocks are collected at one point, and the vital points of the system are all gathered in one box. This makes it easier to locate and easier to prevent trouble. When the system is installed for a week's stand, the main resistance can be placed under the stage and wires run to the cut-out blocks on the stage; it is then only necessary to plug in the lamp and turn on the current. When the resistance is carried on the lamp one is apt to save time by using the cut-out blocks in use by the house, and by having a short circuit blow out the entire house, whereas with the bank of resistance one can always get an independent service. When the resistance is on the lamp it must be carefully protected from contact with the tinsel skirts of performers. This protection at the same time allows less air to circulate, keeps the coils hotter and brings a disagreeable heat on the stage. With the bank of resistance the coils can be kept perfectly free to allow a perfect circulation and by protecting the sides of the box all danger from fire is precluded.

With the individual coils the hum of the coil and the hum of the lamp are brought together to greatly disturb the quiet of the performance. With the "bank" the hum of the coils is practically annulled, and we have only a slight hum of the arc to contend with.

The main reason why the arc lamp has been adopted for stage use is, of course, the economy of space and money. The Brownies Company, under the management of Jefferson, Klaw & Erlanger, used the gas calcium during their first season, for which it was necessary to carry at times 150 tanks, empty and filled with gas. These, together with the lamps, completely filled one-half of a car. The second and third seasons twelve arc lamps were used. These could be packed in eight boxes and the entire outfit barely filled a small-sized express wagon. At the same time the difference in running expenses must have averaged $75 per week.

The Detroit Meeting of the American Association for the Advancement of Science.

The next annual meeting of the American Association for the Advancement of Science will be held in Detroit, Mich., August 9-14. The advance programme has just made its appearance and shows that the physical section will be unusually well provided with papers on electrical subjects. The list of papers to be read before this section embraces the following:

"Screening Effect of Induced Currents in Solid Magnetic Bodies in an Alternating Field," by Mr. Charles P. Steinmetz, General Electric Company, Schenectady, N. Y.; "The Design, Construction and Test of a 1250-Watt Transformer," by Prof. Henry S. Carhart, University of Michigan, Ann Arbor, Mich.; "Electrolytic Action in a Condenser," by Dr. K. E. Guthe, instructor in physics, University of Michigan, Ann Arbor, Mich.; "On the Velocity of Light in a Magnetic Field; by Prof. E. W. Morley, Cleveland, Ohio; Prof. H. T. Eddy, Minneapolis, Minn., and Prof. D. C.

Miller, Cleveland, Ohio; "The Magnetic Survey of Maryland," by Dr. L. A. Bauer, University of Cincinnati, Cincinnati, Ohio; "The Transmission of Radiant Heat by Gases at Varying Pressures," by Mr. Charles Brush, Cleveland, Ohio; "On the Rate at Which Hot Glass Absorbs Superheated Water," by Prof. Carl Barus, Brown University, Providence, R. I.; "A New Method of Determining the Specific Heats of Liquids," by Robert L. Litch, Princeton University, Princeton, N. J.; "On the Coefficient of Expansion of Certain Gases," by Prof. Edward W. Morley, Cleveland, Ohio, and Prof. Dayton C. Miller, Cleveland, Ohio; "The Effect of Heat on the Elastic Limit and Ultimate Strength of Copper Wire," by Prof. Frank P. Whitman, Adelbert College, Cleveland, Ohio, and Mary C. Noyes, Ph. D., Lake Erie Seminary, Painesville, Ohio; "A Method of Obtaining Capillary Canals of Specified Diameter," by Prof. Carl Barus, Brown University, Providence, R. I.; "Kites and Their Use by the Weather Bureau in Explorations of the Upper Air," by Prof. C. F. Marvin, United States Weather Bureau, Washington, D. C.; "Experiments Upon the Acetylene-Oxygen Standard of Light," by Dr. Clayton H. Sharp, Cornell University, Ithaca, N. Y.; "Arc Spectra," by Prof. Arthur L. Foley, University of Indiana, Indianapolis, Ind.; "On the Brightness of Pigmented Surfaces Under Various Sources of Illumination," by Prof. Frank P. Whitman, Adelbert College, Cleveland, Ohio; "Note on the Construction of a Sensitive Radiometer," by Prof. Ernest Fox Nichols, Colgate University, Hamilton, N. Y.; "Photographs of Manometric Flames," by Dr. Edward L. Nichols, Cornell University, Ithaca, N. Y., and Prof. Ernest Merritt, Ithaca, N. Y.; "The Discharge of Electrified Bodies by X-Rays," by Dr. C. D. Child, Cornell University, Ithaca, N. Y.; "A Final Determination of the Relative Lengths of the Imperial Yard of Great Britain and the Meter of the Archives," by Prof. Wm. A. Rogers, Colby University, Waterville, Me.; "The Electric Conductivity of Certain Specimens of Sheet Glass, with Reference to Their Fitness for Use in Static Generators," by Prof. Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio; "Graphical Treatment of Alternating Currents in Branch Circuits in Case of Variable Frequency," by Prof. H. T. Eddy, Minneapolis, Minn.; "On Simple Non-Alternating Currents," by Prof. Alexander Macfarlane, Lehigh University, South Bethlehem, Pa.; "Exhibition of Instruments for Determining the Frequency of an Alternating Current," by Prof. George S. Moler, Ithaca, N. Y., and Dr. Frederick Bedell, Cornell University, Ithaca, N. Y.; "The Predetermination of Transformer Regulation," by Dr. F. Bedell, Cornell University, Ithaca, N. Y., Prof. R. E. Chandler, Salem, Va., and Mr. R. H. Sherwood, Brooklyn, N. Y.; "The Effect of Pressure on the Wave-lengths of the Lines of the Emission Spectra of the Elements," by Dr. W. T. Humphreys, Johns Hopkins University, Baltimore, Md.; "A New Form of Coal Calorimeter," by Charles L. Norton, Massachusetts Institute of Technology, Boston, Mass.; "Notes on the Recent History of Musical Pitch in the United States," by Prof. Chas. R. Cross, Massachusetts Institute of Technology, Boston, Mass.; "A New Form of Harmonic Analyzer," by Dr. Frank A. Laws, Massachusetts Institute of Technology, Boston, Mass.; "A Comparison of Rowland's Thermometers with the Paris Hydrogen Scale, and the Corresponding Correction to His Value of the Mechanical Equivalent of Heat," by W. S. Day, Johns Hopkins University, Baltimore, Md.

The Trans-Mississippi and International Exposition.

Plans are now being perfected for the main buildings of the Trans-Mississippi and International Exposition, which will be held at Omaha, Neb., from June 1 to November 1, 1898. A building will be devoted to electricity and machinery, and will cost about $100,000. The exposition grounds will cover an area of about 200 acres, and are situated within the city limits, being accessible by means of three trolley lines and two steam railroads. It is thought that the various buildings will be filled with exhibits from all over the world. Eastern manufacturers are especially solicitous regarding space. The exposition grounds will constitute a bonded store, and foreign exhibits will be admitted free of duty. It is stated that under an act of Congress medals will be struck off at one of the Government mints, to be awarded to those exhibits deserving honorable mention.

Manager E. E. Bruce, of the Department of Exhibits, offers special prizes consisting of six gold trophies, six silver cups and six gold medals to competitors in various classes, including the best electric light service and display, and the best display of manufacturing plants in operation. Similar prizes will be offered for other high-class exhibits. It is stated that several foreign firms have filed applications for space in the Manufacturers' Building, one having secured 1000 square feet for its purposes, and several others securing nearly as much.

President Wattles, of the Exposition Company, has issued formal invitations to rulers of foreign nations to participate in the exposition, and this has been supplemented by a letter prepared by the State Department at Washington, to American representatives accredited to foreign countries. The mining industry and the three features of agriculture, live stock and mining will constitute the most extensive departments of the exposition. The main buildings will be devoted to agriculture, art, electricity and machinery, mines and mining, manufactures and liberal arts, and a spectatorium.

Simple Method of Making Castings.

Amateurs and others who are experimenting with electrical apparatus and are in need of small castings of rather complicated forms, may often find the following simple method considerably cheaper and quicker than to have a wooden or metallic pattern made. The method is the one used by the Japanese for making their complicated bronze castings. The disadvantage of it is that only one casting can be made, as the pattern is destroyed, but this casting can then be used as a pattern for further ones in the usual way.

The method consists in merely moulding the object in wax, which becomes sufficiently hard to hold its shape but can be easily worked when warmed. This pattern is then surrounded by clay or some refractory material in a very soft state, making a thick solid mass around the whole pattern. When dry it is heated and the wax allowed to run out through holes prepared for the purpose, the metal then being poured in through those same holes.

Proposed Pan-American Exposition.

The incorporation of the Pan-American Exposition Company was recorded at Albany on June 25. The capital of the company is $50,000, and its principal office is in Buffalo. The corporation is formed to promote and conduct an exposition to illustrate the material progress in the New World during the nineteenth century, and it is proposed to hold the exposition at some point on the Niagara frontier in this State. The corporation has the right to purchase or lease such location and to construct such buildings as may be necessary for the purpose for which it is organized. The directors are Roswell P. Flower, Chauncey M. Depew, H. Walter Webb, Daniel O'Day, Edgar Van Etten, William F. Sheehan and E. B. Thomas, of New York City; John M. Brinker, Fred C. M. Lautz, Charles N. Haskins, Charles R. Huntley and Herbert P. Bissell, of Buffalo, and W. Cary Ely, of Niagara Falls.

A Genuine Electrical Burglary.

An enterprising burglar has at last ventured to use the means minutely described in some of our contemporaries for burning holes in a safe. A few days ago the bank of Messrs. Rogers & Son, at Chagrin Falls, Ohio, was found open and on the floor in front of the safe were found burglars' tools, a pile of sand, carbons and wires leading to the tracks and trolley wire of the street railway near the building. It is said that big holes had been melted in the combination lock and the molten metal caught in the trough of sand on the floor below. The current had been shut off from the railway line during the night, and it is supposed that this compelled the burglars to desist.

Electric Speeds.

The *American Machinist* extracts from a contemporary a gamut of speeds per second, beginning with that of the snail, which is half an inch, and ending with the following: "Electric current on telegraph wires, 7000 miles; induction current, 11,040 miles; electric current in copper wire armatures, 21,000 miles; light, 180,000 miles; discharge of a Leyden bottle through copper wire 1-16 inch in diameter, 277,100 miles. This last is the greatest rapidity so far measured." These figures might have more weight and more interest if the methods of calculating them or the authorities had also been given.

Electric Lighting at Bolton, England.

BY HAROLD LOMAS AND HERBERT C. GUNTON.

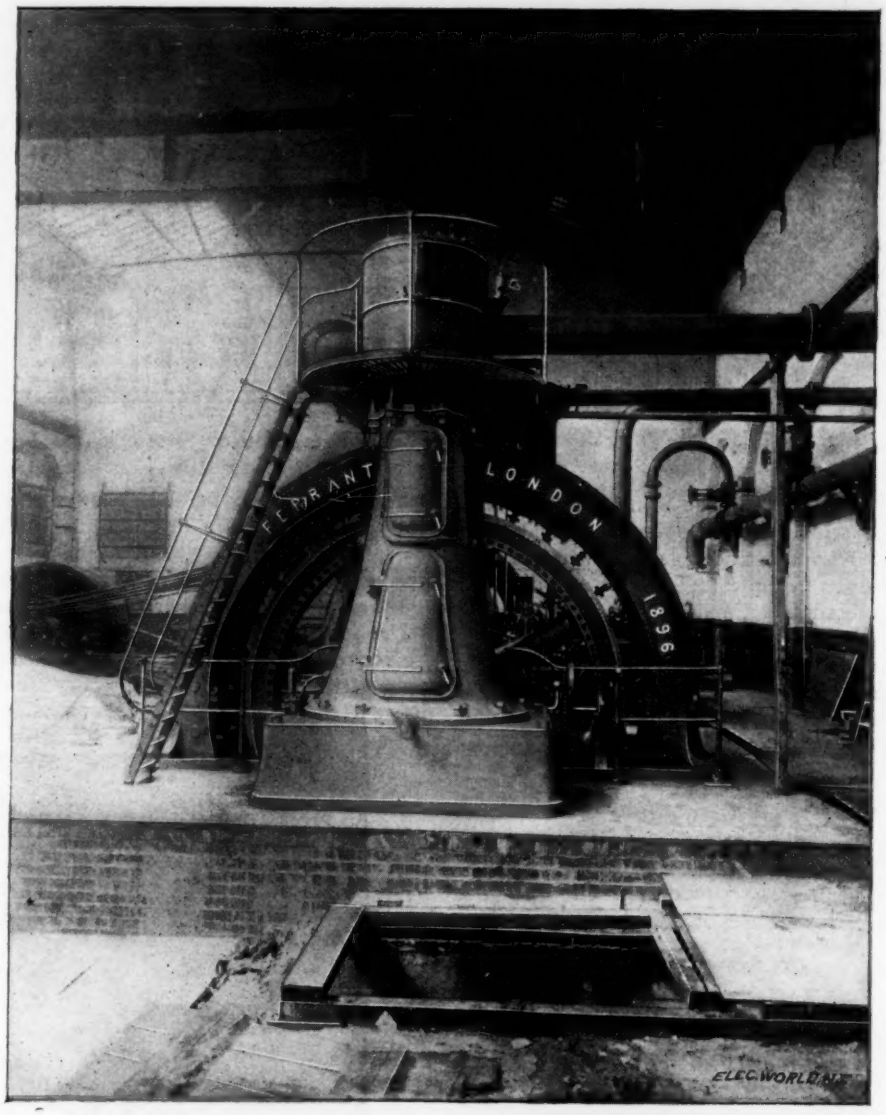
Bolton is one of the many cities in England in which the electric lighting is municipally controlled. In this particular case the corporation has control both of the gas and electric light, and the two stations adjoin one another. Provisional orders for electric lighting were obtained in 1890, the corporation, with the sanction of the Local Government Board, borrowing $200,000. The works were eventually built on the edge of the town, three-fourths of a mile from the centre. The site and the system of distribution, which is somewhat unusual, were only decided upon after considerable deliberation, the scattered residential population affording a somewhat difficult problem to deal with.

Ultimately, alternating current at 2000 volts was laid down, with transformer sub-stations, the current being supplied from these stations on the three-wire system at a pressure of 200 volts across the outside mains.

Naturally enough, the corporation did not deem it worth while to go outside their own county for the steam plant, and so four Lancashire boilers, 30 inches by 7 feet 6 inches, with a working pressure of 120 pounds, were installed. Each boiler has two internal flues of 3 feet diameter, with five Galloway tubes. The equipment of the boilers is a special feature, each being fitted with a Meldrum furnace, the immense utility of which is proved by the fact that it enables coke to be used as fuel, which is obtained from the gas works at the cost of carting, viz., 6d. a ton.

This has to be supplemented at times of the heaviest load by coal, but only three tons of coal are used per week against 60 tons of coke, a very considerable economy being consequently effected.

The feed water is pumped from a tank, fed by the town mains, by two compound vertical Worthington pumps, either through a Berryman feed-water heater, or straight into the boilers.



VERTICAL COMPOUND ENGINE DIRECT COUPLED TO FERRANTI ALTERNATOR.

The station is run non-condensing, as there is no convenient source of water at hand; in fact, water is, comparatively speaking, an expensive item, the charge being 12 cents per 1000 pounds.

The steam-distributing pipes are of wrought iron, with copper bends. One main from each boiler feeds through the wall into the adjacent engine room, the main pipe here being carried entirely around the room. A separator is placed where each main enters the ring, and a Hopkinson stop valve on each side of the separator.

The exhaust pipes pass either through the heater into the stack, or straight into the stack. The first generating plant laid down consisted of three engines built by J. & C. Wood, of Bolton, of a compound-vertical type, with the fly-wheel between the cylinders.

The two larger are of 160 horse-power, with cylinders 13 and 21 inches diameter, and 15 inches stroke, running at 180 r. p. m. The smaller is of 80 horse-power, with cylinders 10 and 15 inches diameter and 12 inches stroke, running at 220 r. p. m. These drive by rope Mordey Victoria alternators, two of them giving 30 amperes and 2000 volts at 600 r. p. m., and the other 25 amperes at 600 r. p. m. The alternators are all mounted on slide rails fitted with tightening screws and ratchet levers, thus admitting of the tightening of the ropes while the alternators are running.

It cannot be said that this first plant has been a great success, so when the demand became such as to require more plant it was decided to put down two Ferranti alternators, direct-coupled to Hick-Hargreaves engines.

As will be seen from the illustration, the engines are vertical compound, with the fly-wheel between the cylinders. The alternators are of the disc type, giving 110 amperes and 2000 volts, the armature being carried by the fly-wheel, which is 10 feet 3 inches in diameter and weighs 8½ tons. The armature coils, of which there are 64, are wound on a laminated metal core, made up of strips of corrugated brass, the corrugations serving to key the laminations together. Bare copper tape is wound on the core, the turns being insulated from each other.

Each pair of coils is carried in a pair of gun-metal clamps, from which they are insulated by mica, the whole being riveted together. The clamps themselves are carried by studs projecting radially from the fly-wheel rim, cored holes being left in the rim in which one end of each stud is fixed by a nut. The hole is then filled with sulphur compound, and the bolt thus formed is further insulated from the rim by an ebonite sheathing, the insulation of the bolt from the rim being tested at 6000 volts. The clamps are then mounted on the radial bolts and drawn home by nuts, the position of the coils being thus easily adjustable.

The armature runs between sixty-four pairs of poles carried by two castings. Each pole piece is wound with copper tape set on edge, the turns being insulated from each other and from the pole pieces by waterproof insulation.

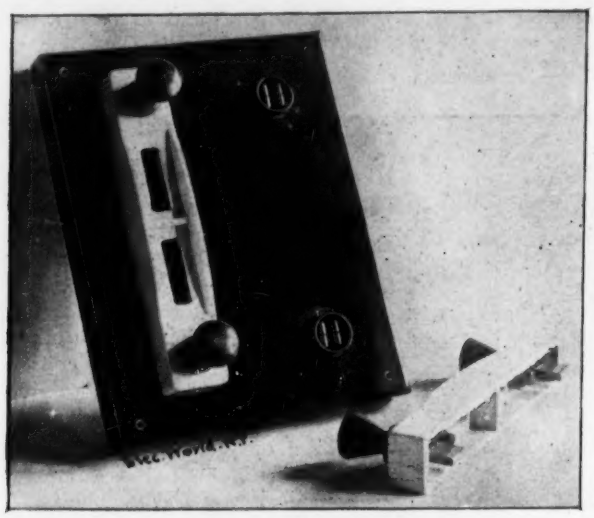
The two castings carrying the pole pieces are bolted together, but are provided with hand-rack gear, so that they can easily be drawn apart for inspection of the armature and pole pieces. The electrical losses are very small, and the combined efficiency of the plant, including the exciting current, which is about 1¾ per cent., is 88 per cent.

For supplying the exciting current a small direct-driven plant and cells are used, the exciters consisting of two Brush two-pole dynamos, direct-driven by Roby engines. Each of these machines can give 90 amperes at 100 volts, or 70 amperes at 130 volts. When charging the cells, in addition to these there is a Crompton dynamo driven off the shaft of the smaller Mordey alternator, which may serve as an exciter, or it may be run as a motor from the battery and drive the alternator, thus permitting steam to be shut down at light loads.

To effect this the engine pulley on the alternator shaft is fitted with a friction clutch, which is thrown out of gear when the engine is shut down.

The controlling apparatus, one of the first switchboards built by the Manchester Edison Company, is placed in a gallery at the end of the generating room, and is provided with panels for the feeder circuits, alternators, exciters, cells and synchronizing arrangement.

The mains from the machines are concentric, the outer being earthed throughout the whole system. One bus bar connected to the outer runs horizontally behind the board, the feeder circuits being taken off on the right. As will be seen from the illustration, each feeder panel contains a double-pole switch and fuse at the bottom, ammeter and Kelvin multicellular voltmeter at the top, and the regulating apparatus in the centre.. This was devised by Mr. Rider, the late borough engineer, and consists of a primary winding in shunt with the mains and a secondary in series with them. The primary is a movable core, and when in the position of maximum induction generates 200 volts and 36 amperes in the secondary. The adjustment is made by a handle in front of the board, which is attached by gearing to the movable parts of the regulator, and by this means any required voltage between 200 and zero can be generated in the secondary.



Feeder Panel Fuse.

The Kelvin voltmeter indicates the voltage on the low tension side of the transformers.

The centre panel contains the apparatus for controlling the exciters and cells; the left of this panel is devoted to the exciter referred to as driven off the small alternator shaft, and contains ammeter and voltmeter, double-pole field switch, field-regulating apparatus, automatic single-pole main-switch and double-pole fuse. The right is precisely similar, and contains the instruments for the other two exciters, two main-plug switches being provided so that either, but not both, of these machines can be used at once.

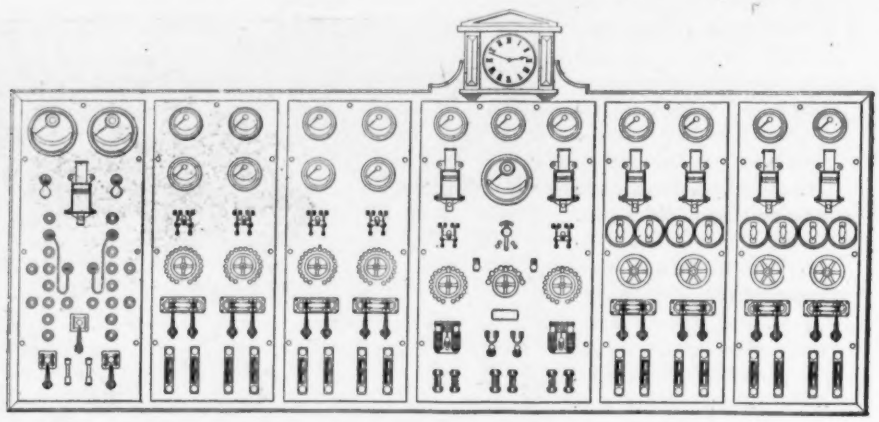
The centre is occupied by the battery instruments, the double-pole-switch at the bottom throwing the cells onto the exciting bus bars.

On the left are the alternator panels, each alternator having a main ammeter, field ammeter, switches and regulating resistance and main double-pole switches and fuses.

The synchronizing panel adjoining is exceedingly simple, the little plug switches being used for connecting any alternator to either voltmeter.

The diagrammatic sketch shows the connections.

The lamps are on one secondary, and the right moment for synchronizing is determined by the steady burning of the lamps.



Elevation of Switchboard, Bolton Plant.

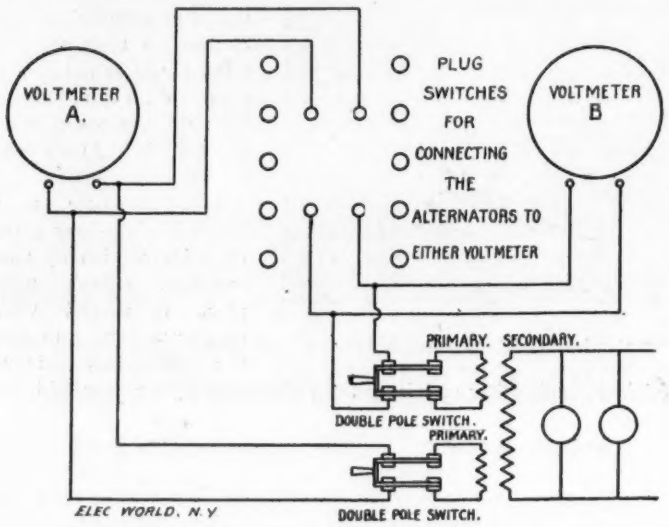
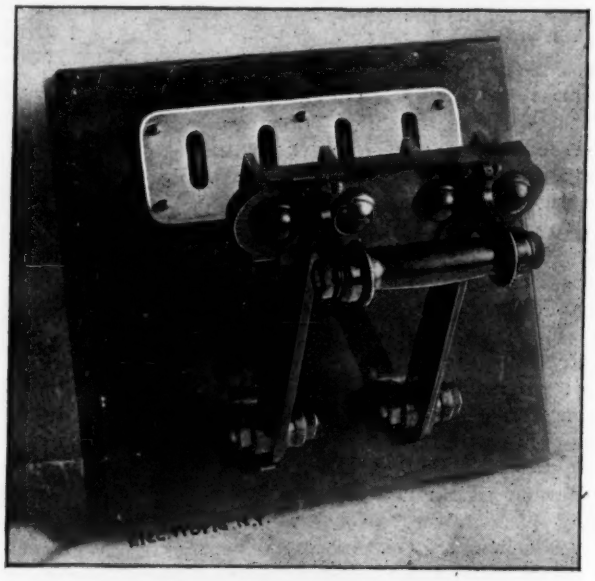


Diagram of Connections of Synchronizing Panel.

Subsequent to the building of the switchboard, an addition was made by which extra flexibility is obtained. This consists of a system of plugs, by which means any machine can be put exclusively onto any feeder. These plug switches are on the inner and in series with the inner on the feeder double-pole switches.

The feeders, which have a cross-sectional area of 0.0349 inch, are concentric, insulated with vulcanized india rubber and armored with galvanized steel wires. They run through cast-iron pipes direct to the transformer chambers, of which there are five. These stations contain Mordey Victoria transformers, built by the Brush Company, of their 18-kw size, and are arranged to run on the three-wire system.



Double-Pole Switch.

Owing to the scattered nature of the residential population, it has been impossible to entirely avoid house-to-house transforming, and there are forty customers of this kind.

The low-tension mains, which are three-core cables, are laid directly in the ground. The demand has increased so much lately that these cables are overloaded, and so it has been determined to

rewind the transformers and have 200 volts between the outer and neutral mains, in which case the corporation will, of course, renew the lamps.

The average cost of generation per kilowatt hour over the last six months is about 2½ cents, but this does not include, as in most American stations, the providing and renewing of lamps, etc.

As regards the price of the current, the Wright maximum-demand system has recently come into use.

In this system the demand meter indicates the maximum current delivered to the consumer's lamps at any time, and also registers the number of units to be consumed before the customer is entitled to the lower tariff.

The charges are at the rate of 6d. per unit for an average of one hour per lamp per day, and 3d. per unit for all current over such average, less 10 per cent. discount if paid within twenty-one days of receipt of bill.

Unless the quantity consumed is equal to one hour's consumption per day of the greatest quantity of electricity used at one time, the charge is 6d. per unit for the whole quantity consumed, but on anything over the said hour's average consumption the charge will be 3d. per unit.

It will be interesting to note the future development of Bolton, as it is intended to have electric traction there. At present horse cars are used, the Bolton Tramway & Carriage Company leasing the line from the corporation; the corporation, however, have it in their power to compel the company to put down any other form of traction which they can prove cheaper; and the bill with reference to the installation of electric traction is now before Parliament. The trolley system is to be used, and it is estimated that the cost of the electrical equipment will be £4200, or $21,000 per mile, the total length of the track being about thirty-one miles.

The traction and lighting plants are to be run in conjunction, and it is intended to put down two more Ferranti alternators. The line is to be supplied from a motor generator station, possibly in conjunction with a battery on the longest route, which is 6 miles, though at this stage it is impossible to speak definitely. The Local Government Board have granted the corporation an extension of their borrowing powers, and they intend to take control of the electric traction when that is installed.

An Electrically Operated Bridge.

BY J. E. WOODBRIDGE.

At the head of Lake Superior, spanning the St. Louis river, there is now almost completed a bridge which is interesting for its novel electrical features. The bridge connects the cities of Duluth, Minn., and Superior, Wis., and is designed to carry steam traffic, trolley cars, street vehicles and foot passengers.

Over the centre of the river is a large draw, so heavy and so long that the ordinary mechanical methods of working the end mechanism from the centre of the draw were considered insufficient, and electrical transmission was adopted instead.

This draw is almost exactly 500 feet long, 58 feet wide, 88 feet high, and weighs approximately 2000 tons. A double track for steam trains runs between the truss members, the trolley tracks, roads and sidewalks being carried on the overhanging ends of the floor beams on either side.

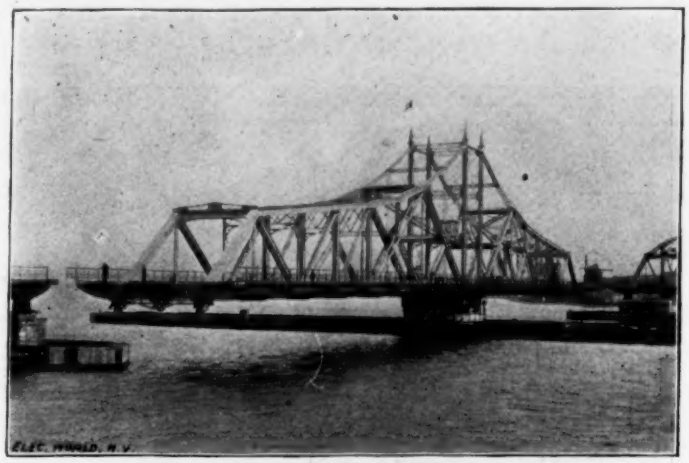
The draw-span is turned by two G. E. 2000 street-railway motors, working through complete duplicate sets of mechanism, so that in case of a breakdown in either set the other may be used alone.

Near each end of the draw-span and just below the floor level is placed a G. E. 1200 motor. The duties of these motors are threefold; first, to operate the end lifts; second, to release the latches, and third, to raise the rails.

When the draw is closed its ends must be firmly supported on the end piers to prevent the tilting up of either end by loads rolling on at the other. The weight of the ends of the draw is transferred to the end piers by what are called the end lifts. In this particular bridge these consist of massive steel eccentrics, from which hang short stout eccentric rods pivoted at their lower ends to solid steel blocks or shoes. Two of these sets are slung under each end of the draw-span.

When the bridge is closed the eccentrics are turned down, which lowers the shoes onto pedestals on the masonry piers and lifts the weight of the ends of the draw onto them. The throw of the eccentrics is 4 inches; the clearance under the shoes when lifted is 2 inches, so that a lift of 2 inches is given the draw ends. The estimated load with this life is 50 tons per eccentric. Temperature changes in the length of the draw-span are provided for in these short eccentric rods or struts, by leaving them free to rotate at both ends in a vertical plane lengthwise of the draw.

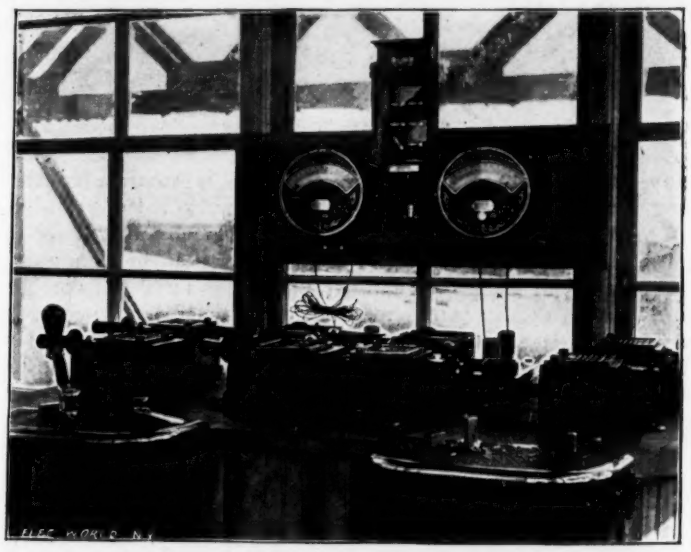
To provide for the expansion of the rails on the draw they are made to overhang the ends of the draw and terminate in a long bevel, which fits snugly beside a similar beveled end of the rails on



GENERAL VIEW OF BRIDGE.

the adjacent spans. Before opening the bridge, these draw rails must be lifted clear of the others. This is done by the same motors that work the end lifts, the rails being lifted when the ends are lowered and vice versa. It is noticeable that only the steam tracks are so fitted, the trolley-car rails being cut off square.

The latches, which are ordinarily worked by hand from the centre of the draw by long rods or shafts, are arranged in this bridge to be operated by the end lift motors. Each latch is lifted when the ends are lowered, by a trigger on the end lift shaft. When the bridge turns the latch is raised still higher by riding over a projection, which releases the trigger and allows the latch to fall into the



CONTROLLERS, SWITCHES, ETC., IN OPERATING HOUSE.

jaws when next it rides over them. The jaw openings are so proportioned that the latches will not fall into them unless the bridge is turning very slowly, thus obviating the risk of the strains which would be produced by abruptly stopping such a heavy draw-span. The jaws are also supplied with heavy spring centering buffers.

The motor operating these devices is geared down first through standard street railway single-reduction gears, then through a worm and twenty-tooth worm wheel, and finally through another set of spur gears. To prevent the apparatus being brought up short by the running away of a motor, the eccentric shaft is turned by a long crank, driven through a floating link by a shorter crank. With this arrangement, continuous rotation of the shorter crank only causes oscillations of the long crank and eccentric shaft. The

shorter or driving crank also comes to centre at the same time that the eccentric does, giving the motor an enormous leverage on the load. Attached to the motor shaft is a powerful strap brake, applied by gravity and released by an electromagnet, which is connected in series with the motor. This serves to stop the mechanism as soon as the current is turned off.

The bridge-turning mechanism differs in no essential features from ordinary practice, except in point of size. The speed reduction from the armature shaft to the bridge column is about 1500 to 1. The teeth of the final pinion and rack are 10-inch face by 4-inch pitch. The turning motors also are supplied with magnetically released brakes, which are controlled by separate switches, so that the bridge may be allowed to drift, or slowed up, at will.

Motor and Machinery for Turning Bridge.

The operating cabin is built on an elevated platform above the railroad tracks, where an uninterrupted view can be obtained of the harbor and the bridge approaches. It is fitted out complete with series-multiple controllers, cut-outs, switches, lightning arresters, Weston station ammeters and voltmeter, and electric heaters. The motors are worked, as a rule, in series connection; rheostats and throw-over switches being provided so that any motor can be cut out and replaced by a rheostat at any time. An annunciator is wired up to indicate when the bridge is exactly in the closed or open position, also when each end lift is fully up or fully down.

Power was first applied to the draw about the 1st of June, the mechanism working without a hitch from the beginning, which is somewhat remarkable, considering the boldness of resource necessitated by the problem. The time required to swing the bridge 90 degrees is less than two minutes.

The bridge was built by the Pennsylvania Steel Co., the machinery being built from the special designs of Mr. W. T. Sears.

A Novel Remedy Against Leakage.

An article in a contemporary explains the fact that the leakage in a certain case was small, in the following terms: "The conductors are so large that there seems to be no incentive (sic) for the current to leave them." If the author had touched a large, bare conductor carrying a small, high-potential current, grounded at the other end of the circuit, he would have found, if he survived the test, that the "incentive" was independent of the size of the conductor.

Alternating-Current Machinery.—XII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

106. As an example of impedance in alternating-current circuits, we may consider the case represented in Fig. 66. Here a small alternator, A, has a resistance of 0.1 ohm, and an inductance of 0.0015 henry. The ammeter and switchboard apparatus, a, has a resistance of 0.02 ohm and an inductance of 0.0005 henry. The two parallel copper wires, BC and DE, are each one mile in length of No. 0 gauge, and are supported on poles at an interaxial distance of two feet. LL is a bank of 110-volt incandescent lamps in multiple, having a resistance, when hot, of 5 ohms and a negligible inductance. We may assume that the alternator develops a sinusoidal E. M. F. at a frequency of 125 ~ It is required to determine the pressure and current through the circuit.

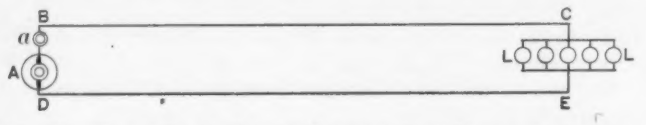


Fig. 66.—Diagram of Simple Alternating-Current Circuit.

Here the angular velocity $\omega = 2\pi \times 125 = 785.4$.

	Ohms.
The inductance of the alternator being 0.0015 henry its reactance is $j\,x = j\,l\,\omega$ $785.4 \times 0.0015 =$	j 1.178
The inductance of each wire (¶82) is 1.688 millihenry = 0.001688 henry and the reactance of each wire i $785.4 \times 0.001688 = j$ 1.325, or for both	j 2.650
The inductance of the ammeter being 0.0005 henry, its reactance is j $785.4 \times 0.0005 =$	j 0.393
The total reactance in the circuit is	j 4.221
The resistance of the alternator is	0.1 ohm
The resistance of the ammeter is	0.02 "
The resistance of each wire is approximately 0.52 ohm, or for both	1.04 "
The resistance of the lamps hot is	5.0 "
	6.16 ohm

The impedance of the entire circuit is, therefore, $6.16 + j\ 4.221$ ohms $= \sqrt{6.16^2 + 4.221^2} = \sqrt{37.95 + 17.82} = \sqrt{55.77} = 7.681 \angle \tan^{-1} \frac{4.221}{6.16} = 7.468 \angle \tan^{-1} 0.6854 = 7.468 \angle 34^\circ\ 25'$. In order to send a current of 22 amperes through this circuit the E. M. F. developed in the alternator must be $22 \times 7.468 = 164.3$ volts.

107. The drop of pressure in a continuous-current circuit is $E = I\,R$ volts, where I is the current strength in amperes and R is the resistance which it traverses in ohms. In the simple alternating-current circuit the drop of pressure which occurs when a current of I amperes traverses an impedance of Z ohms is $E = IZ$ volts. This is, however, a vector formula, since in the most general case E, I and Z are all vectors. Consequently the multiplication must be effected according to vectorial rules.

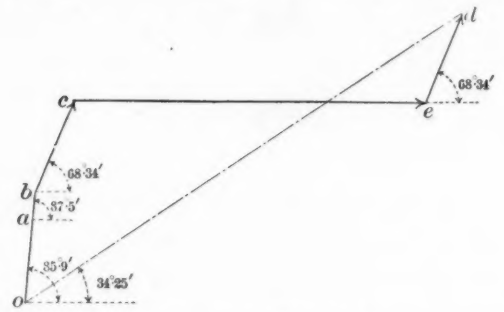


Fig. 67.—Impedance Diagram of Simple Alternating-Current Circuit.

Thus in the circuit above considered the impedance

of the alternator	is 0.1	$+ j$ 1.178	$= 1.282$	$\angle 85^\circ\ 9'$
of the ammeter	is 0.02	$+ j$ 0.393	$= 0.398$	$\angle 87^\circ\ 5'$
of each line	is 0.52	$+ j$ 1.325	$= 1\ 473$	$\angle 68^\circ\ 34$
of the lamp	is 5.	$+ j$ 0	$= 5$	$\angle 0^\circ$

If we take the phase of the current as zero or standard, the current

strength in the circuit is 22 /0° amperes. Consequently the drop of pressure in the lamp is

$$22\ /0^\circ \times \quad 5\ /0^\circ \quad = 110\ \ /0^\circ \quad \text{volts}$$

drop of pressure in the first line is

$$22\ /0^\circ \times 1.423\ /68^\circ\ 34' = 31.31\ /68^\circ\ 34' \quad ''$$

drop of pressure in the second line is

$$= 31.31\ /68^\circ\ 34' \quad ''$$

drop of pressure in the ammeter apparatus is

$$22\ /0^\circ \times 0.398\ /87^\circ\ 51' = \ 8.76\ /87^\circ\ 51' \quad ''$$

drop of pressure in the alternator is

$$22\ /0^\circ \times 1.182\ /85^\circ\ 9' = 26.0\ \ /85^\circ\ 9' \quad ''$$

The arithmetical sum of these is 207.38 volts, but owing to the fact that they are not equiangular, the actual E. M. F. in the circuit, which must be equal to their vector sum, is 164.3 volts. This is represented in Fig. 67. Here *o a* is the drop of pressure in the alternator, or the E. M. F., which is expended in overcoming its impedance = 26 /85° 9′ volts. *a b* is the drop of pressure in the ammeter apparatus or 8.75 /87° 5′ volts, *b c* is the drop of pressure in the line *B C*, Fig. 66, or 31.31 /68° 34′ volts, *c e* is the drop of pressure in the lamps, or 110 /0°, and *e d* is the drop of pressure in the return conductor *D E*, or 31.31 /68° 34′. A voltmeter connected in succession across the terminals of these impedances would show

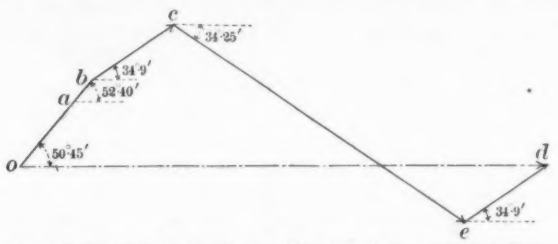


FIG. 68.—PRESSURE DIAGRAM IN SIMPLE ALTERNATING-CURRENT CIRCUIT.

pressures equal to these magnitudes successively. The total E. M. F., *o d*, required to overcome the total impedance of the circuit is 164.3 volts to the same scale. This is the E. M. F. which must be developed in the alternator, and it leads the current by 34° 25′; or, in other words, the current lags behind the E. M. F. by this angle. Consequently, the drop of pressure in alternator and mains is 164.3 — 110 = 54.3 volts, instead of being 207.4 — 110 = 97.4 volts, as might be supposed from an arithmetical addition of separate drops. The pressure across the dynamo terminals or collector-rings will be a vector *a d*, which measures 149 /26° 40′, so that although the current is 34° 35′ in phase behind the generated E. M. F., it is only 26° 40′ behind the pressure at the generator terminals. Similarly a vector, *b d*, drawn from *b* to *d*, would measure the pressure as shown by a voltmeter between the two terminals *B* and *D* of the lines. This vector would be 145.1 /23°4. The apparent drop in the lines as measured by the difference in the pressures at *CE* and *BD* is 145.1 — 110 = 35.1 volts; while the sum of the drops in the lines as measured by voltmeters between *B* and *C* and *D* and *E* = 62.6 volts. Consequently, the apparent drop in a circuit is never greater and is usually less than the sum of the individual drops. Finally *cd*, drawn from *c* to *d*, would have a length of 124.9 units and an angle of /13° 30′, so that a voltmeter connected between points *C* and *D*, Fig. 68, would indicate 124.9 volts.

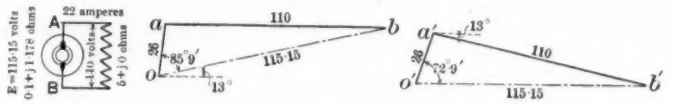


FIG. 69.—PRESSURE DIAGRAMS IN SIMPLE ALTERNATING-CURRENT NON-INDUCTIVE CIRCUIT.

108. It will be evident from an inspection of Fig. 67, that this figure, in addition to being a pressure diagram, is also an impedance diagram to a scale 22 times larger. For each vector composing it has been obtained by multiplying the corresponding impedance by 22 /0°, the current strength. Thus *o d* may be considered as representing the impedance of the entire circuit, namely, 7.468 /34° 25′ ohms. Similarly, vectors which might be drawn between any two points of the diagram would also represent the corresponding impedance between those points. Thus, a vector *b d* would represent the impedance between the ends, *B D*, of the lines in Fig. 66.

109. In constructing the pressure diagram of Fig. 67, we took the phase of the current as standard, or imagined that the vector current was directed horizontally at an angle /0° If, however, we take the phase of the E. M. F. as standard, then from the total impedence of the circuit we know that the current is 22 /34° 25′, with reference to this standard. Consequently, the drop of pressure in any one of these impedance will be reduced by the angle 34° 25′ as compared with the drop shown in Fig. 67. Thus the drop of pressure in one of the lines if $E = IZ = 1.423\ /68^\circ\ 34' \times 22\ /34^\circ\ 25' = 31.31\ /34^\circ\ 09'$. If we continue this process through all the impedances we obtain Fig. 68, which differs only from Fig. 67 in being rotated through 34° 25′. The pressures in Fig. 68 are all referred to the phase of the generated E. M. F. as standard.

110. The circuit which is analyzed in Figs. 66-68 is a hypothetical circuit, such as is never completely realized in practice. In the first place the E. M. F. generated in a practical circuit is never strictly sinusoidal, and often differs considerably from the sinusoidal in type. The non-inductive load, *L L*, is seldom connected directly to the ends of the lines one mile in length, and is usually connected through transformers which have iron cores. There is always, in practice, some armature reaction in the alternator, *A*, and the influence of the iron is also felt in this armature. Nevertheless all the departures which may occur in practice from such ideal cases are best treated as deviations from the simple type for

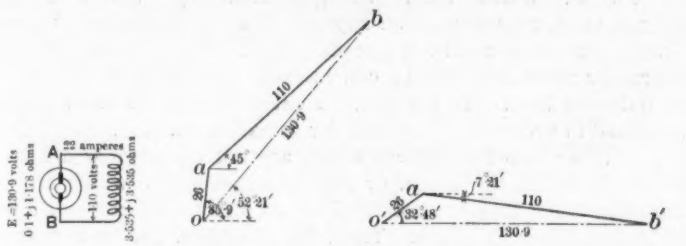


FIG. 70.—PRESSURE DIAGRAMS IN SIMPLE ALTERNATING-CURRENT INDUCTIVE CIRCUIT.

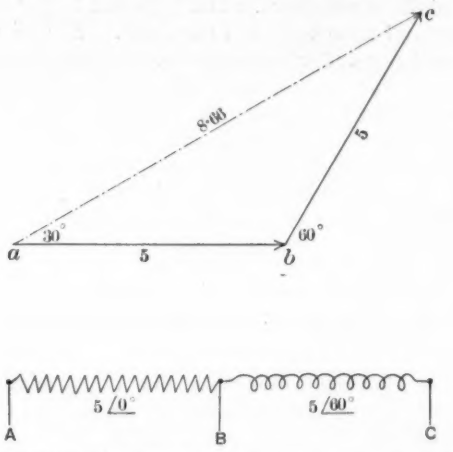


FIG. 71.—COMBINATION OF AN INDUCTIVE WITH A NON-INDUCTIVE RESISTANCE IN SERIES.

which corrections can, when necessary, be made. In the majority of cases the degree of approximation which is obtained by neglecting these corrections is sufficient for practical purposes, and in some cases the deviations from the simple harmonic treatment are very small, so that the sinusoidal analysis of alternating-current circuits is not only the simplest, but the most practical yet devised.

111. The drop of pressure which takes place in an alternator of given impedance has, of course, the same numerical value, whatever be the phase of the current which it supplies, neglecting changes in armature reaction, but the apparent drop at machine terminals, and the consequent increase in excitation which must be given to the alternator to maintain a constant terminal pressure, vary considerably with the phase of the current, and, therefore, with the character of the load.

Thus, if we suppose the alternator considered in connection with Fig. 66, to supply a current of 22 amperes to a non-inductive load

of 110-volt lamps connected directly to its terminals, the impedance of the alternator is $0.1 + j\ 1.178$ ohms, and the impedance of the lamps is $5 + j0$ ohms, so that the impedance of the circuit is $5.1 + j\ 1.178 = 5\ 234\ \underline{/13^\circ}$ ohms and the E. M. F. which will be required to send a current of 22 $\underline{/0^\circ}$ amperes through this impedance will be $22.0\ \underline{/0^\circ} \times 5.234\ \underline{/13^\circ} = 115.15\ \underline{/13^\circ}$, so that the apparent drop of pressure will be $115.15 - 110 = 5.15$ volts, as represented in Fig. 69, where $O\,a$ is the drop of pressure in the alternator referred to the phase of the current as standard, and $O^1\,a^1$ the same drop referred to the phase of the generated E. M. F. as standard; $a\ b\ a^1\ b^1$ are the pressures at the terminals to the same standards, respectively. Suppose, however, that the machine has to supply 22 amperes through an inductive resistance of $5.0\ \underline{/45^\circ}$ ohms, the resistance in this impedance will be 3.535 ohms and the reactance j 3.535 ohms, so that the total impedance in the circuit will be $(0.1 + 3.535) + j\ (1.178 + 3.535) = 3.625 + j\ 4.713$ ohms $= 5.952\ \underline{/52^\circ\ 21'}$, and the E. M. F. required to send a current of 22 $\underline{/0^\circ}$ amperes through this circuit will be $130.9\ \underline{/52^\circ\ 21'}$ as shown in Fig. 70. Consequently, although the pressure at machine terminals is the same as before, namely, 110 volts, yet the E. M. F. which must be generated by the alternator is 130.9 volts, representing an apparent drop of 30.9 volts, or about six times as much as in the preceding case. The excitation of this alternator must therefore be considerably greater when it supplies an inductive load. In practice, the excitation must be still further increased in order to compensate for armature reaction.

112. When two impedances which are not equiangular are connected in series, the drops, or potential differences which are established when they are traversed by an alternating current, differ correspondingly in phase. Thus, let $A\,B$, Fig. 71, be a non-inductive resistance of 5 ohms, and $B\,C$ an inductive resistance, or impedance, of $5\ \underline{/60^\circ} = 2.5 + j\ 4\ 33$ ohms. Then the total impedance, between A and C will be $7.5 + j\ 4.33 = 8.66\ \underline{/30^\circ}$ ohms, as shown in Fig. 71. Suppose, for example, that a current of 10 $\underline{/0^\circ}$ amperes passes through the series, then the pressure between the terminals A and B will be 50 $\underline{/0^\circ}$ volts, the pressure between B and C will be $50\underline{/60^\circ}$, and the pressure between A and C $86.6\ \underline{/30^\circ}$ volts. Consequently, the pressure at the terminals of the inductive resistance will be 60° out of phase with the pressure at the terminals of the non-inductive resistance, while both will be 30° out of phase with the pressure between the end terminals. Such a combination of inductive and non-inductive resistance is sometimes used for the purpose of obtaining two potential differences, which are relatively dephased by a definite amount. It will be evident, however, that if a shunt be connected across the terminals $B\,C$, the impedance existing between B and C, will be altered by reason of the presence of the shunt, so that the application of shunts to receive the dephased pressure modifies the amount of phase difference available.

(*To be continued.*)

The Employment of Carborundum for Fine Scale Divisions.

The London *Electrician* says that the Physikalisch-Technische Reichanstaldt is now using carborundum crystals to a great extent to replace diamonds in the production of finely divided scales. Small flat hexagonal crystals are chosen of from ½ to 1 mm. size and mounted in a steel holder by means of a drop of shellac. The lines are said to be much more even than those produced by a diamond. They have been examined when magnified fifty times and found to be still sharply defined.

The Pender Memorial.

A London dispatch dated June 28 states that the committee in charge of the International Submarine Telegraph memorial to the late Sir John Pender, proposes to place in some suitable institution a bust of Sir John Pender, not to exceed in cost £500; to endow an electrical laboratory at the London University with not less than £5000; to establish a chair to be known as the Pender Chair of Electrical Engineering, and to found a Pender scholarship and gold medal at the Glasgow University. The amount of subscriptions already received by the committee is £6000.

A Physical Theory of Electricity and Magnetism.

BY T. PROCTOR HALL.

1.—Introduction.

It has long been known that electricity is a form of energy, and not a fluid. Maxwell assumed that this energy takes the form of stresses and strains of the ether, and from this assumption he deduced mathematically many of the laws of electric action. His prediction of the identical nature of electric waves and light waves, followed by Hertz's brilliant experimental confirmation, has made Maxwell's theory the only one worth consideration.

Unfortunately the highly mathematical character of Maxwell's theory has placed it beyond more than the vaguest comprehension of the great majority of students and practical electricians. It is to remedy this defect and to supply a simple and easily apprehended physical view of electric and magnetic phenomena, that I propose the following theory.

An Electric Current is a Cylindrical Rotation of Ether-Filaments.

This hypothesis implies that a closed current is a large vortex ring; an electric charge is a twisting strain in the ether; an E. M. F. a twisting stress, or "couple"; magnetism is a shear, perpendicular to the direction of the electric current, or about the axis of the rotating filaments; and an ordinary light wave is a cylindrical wave.

Ether. is the name given to the substance that carries light-waves from the sun and stars to the earth. Ether is not like ordinary matter. There is no evidence that it consists of molecules or atoms of any sort. It cannot be seen and handled like ordinary matter, yet its existence is evident (for waves imply a medium) and some of its properties are as well known as those of air and water. It carries waves of light, and therefore has elasticity and mass, or inertia. The wave vibrations are found to be perpendicular to the line of advance. Only solids can convey such waves. The ether therefore acts as a solid. On the other hand we move about, and the planets move in their orbits with no appreciable resistance from the ether. Its density must then be very small, and for such relatively slow motions it behaves as a fluid. In the best vacuum that can be made, the phenomena of light and electric or magnetic force appear almost unchanged, showing that the ether is there as before. Ether can therefore flow easily through solids and liquids, and exists between the atoms of all substances. It does not pass between atoms without some resistance, for (1) Michelson and Morley have shown that the ether close to the earth's surface moves with the earth round the sun, and (2) ether waves (light) cause and are caused by vibrations of atoms (heat), and sometimes (as in photography) separate the atoms of a molecule. The ether is not a conductor of electricity unless atoms of some kind are present in it, but it readily conveys electric and magnetic strain.

Some of the properties of the ether seem to be inconsistent; but, as pointed out by Lord Kelvin, similar paradoxes are found in the properties of ordinary matter. A piece of pitch which is sufficiently solid to be shattered like glass by a blow from a light hammer, yields without breaking to a very moderate, steady pressure, and will even flow like a liquid in its containing vessel if given plenty of time. The ether, similarly, is fluid for such slow motions as those of a cannon ball or a planet, which do not exceed a few hundred kilometers per second; but is a solid for such high velocities as that of light, which is nearly 300,000 kilometers per second. Again, some of the metals which are malleable and ductile, like copper, are, for very small strains, perfectly elastic and retain their form against a small force for an indefinite time. The ether in like manner is perfectly elastic within a certain limit, and beyond that limit yields easily before any force.

The ether may then be described as a fluo-solid of great elasticity and extreme tenuity; unlike ordinary matter, but in some respects analagous with it; existing between atoms and in all space as far as light can travel; the energy-carrier of the universe. We are in it, and it is in us. We see wholly by its waves, and feel them in the sunshine and in the warmth of a fire. It is not a distant unknown, but something as familiar as air.

Lord Kelvin has estimated that its density is 10^{-22} times that

of water; in which case the mass of a portion of ether as large as the earth is the same as the mass of an iron ball forty-three centimetres in diameter (100 kilograms).

A VORTEX RING is sometimes seen curling upward from the smokestack of a locomotive. A small one may be made by dropping a little ink into a glass of clear water. A vortex line is a line whose direction is at every point the same as the axis of rotation of the fluid particles at that point. A vortex filament is a very small filament bounded by vortex lines. A property of vortex filaments, shown mathematically, is this: The product of the sectional area by the velocity of rotation is constant along each filament. The filaments must then form closed curves, or else end on the free surface of the fluid.

II.—ELECTRIC CURRENTS.

There are two, and only two, directions of rotation about a given axis, so that there can be on this hypothesis two and only two kinds of electric currents. These are such that if one is taken as positive the other is negative, for the sum of equal quantities of the two kinds of rotation is zero. The direction of rotation corresponding to a given current is unknown. In order to relate our conclusions to the ordinary language of electricity we assume that the rotation is right-handed or clockwise, in a positive current going from the observer. This may be remembered by thinking of a right-handed screw, which moves from the observer when given a right-handed twist.

When a cylinder having a right-handed rotation is viewed from the other end the rotation is left-handed. The same electric current, therefore, is either positive or negative, according to the point of view.

It is evident that energy may be conveyed by a current in either direction, just as by a shaft in a machine shop.

A conductor is a substance whose atoms are so arranged as to permit the ether filaments among them to rotate more or less rapidly for the slightest twisting stress, so that in the steady state there is no perceptible ether strain within the body. A good conductor permits the rotation to take place with very little loss of time and energy. A poor conductor allows the rotation to take place more slowly, with transformation of a large share of the energy into heat. A non-conductor is a substance which will not allow any continuous rotation of ether filaments within it without alteration of the existing arrangement of the atoms. Bodies which allow electric strain (with or without rotation) to be conveyed through them are called dielectrics.

The stress which tends to produce an electric rotation is a mechanical "couple." The intensity of this force at any point is called the electrical potential at that point. The difference of potential at any two points is called the E. M. F. between them.

In any conductor let

A = area of cross section, in square centimeters,
N=number of filaments per square centimeter section,
S = radius of each filament,
ω = velocity of rotation of each filament, in radians per second,
V = potential = force-couple on each filament, reckoned in dynes—at the end of a radius,
I = current = whole circumference-rotation of the filaments per second,
= $A \omega n s$ when the filaments are assumed circular in section.

I, at potential V, is the sum of the products of the distance moved

Then the activity or power, P, in ergs per second, of a current, per second by the end of the radius of each filament, multiplied by

$$P = An. \omega s V = IV.$$

The work done in maintaining the current for t seconds is

$$W = Pt = IVT.$$

Unit potential is a stress of one dyne on the circumference of each fiiament. This is numerically the same as the work done by the force during a circumference-motion of one centimeter, or to the activity per unit current;

$$V = \frac{P}{I} = \frac{W}{It}.$$

The current in any circuit, being a vortex ring, is constant throughout the circuit. A conductor whose potential at one end is V, and and at the other V_2 has done upon it by the current

$P = I V_1 - IV_2 = IE$ ergs per second, where $E = V_1 - V_2$ is the E. M. F. producing rotation in the conductor.

The energy of rotation of the filaments in the conductor is expended in two ways: First, some atoms are displaced in such a way that their potential energy is increased. The number so displaced in a second will be, in general, proportionate to the whole amount of rotation per second; in other words, to the current. The work done in this way is the product of the number of atoms so displaced into the work required for each displacement; and may be written DI, where D is a constant for any one conductor under constant conditions, and is the work of dissociation for unit current. Secondly, atoms in their oscillations (heat) are constantly striking into the rotating filaments, and receiving from them an impetus which gives a velocity, v, proportional to ωS. These atoms after impact either oscillate more strongly about their original positions or ultimately take up new positions where their potential energy is on the average the same as before. In either case the work done on each atom of mass m is $\frac{1}{2} m v^2$ The whole work is done in this way is the sum of all such products, and may be represented by $R I^2$ where R is a constant for any one conductor under constant conditions.

Hence the activity of a current, the ergs per second done by it in a conductor, is of the form

$$P = DI + RI^2.$$

In a homogeneous isotropic conductor, such as a pure annealed metal, there is no dissociation, or $D = o$, and therefore

$$P = RI^2 + IV,$$

hence $V = RI$, (Ohm's law.)

The number of atoms per second whose velocity is increased by the rotating filaments is evidently a function of the temperature; and the resistance tends to become zero at the absolute zero of temperature (—273° C.).

In a homogeneous conductor of variable cross section, we have A variable as we pass along the conductor, while $I = A n s \omega$ is constant. n being also constant, $s \omega$ varies as $\frac{I}{A}$. The work per second, P, done in a short section of the conductor whose resistance is R, varies as A and also as $(s \omega)^2$, or as $A (s \omega)^2$, or as $\frac{I}{A}$.

But $P = RI^2$, and I is constant,
hence P varies as R,
therefore R varies as $\frac{I}{A}$; or the resistance varies inversely as the cross section.

The work RI^2 done by a current I upon a conductor whose resistance is R appears as heat. If H be the number of calories developed in t seconds by the current, and J is the number of ergs represented by one calorie; then

$$JH = RI^2t, \quad \text{(Joule's law).}$$

III.—ELECTRIC CHARGES.

When a twisting force, V, acts upon an ether filament of radius, s, which passes into a non-conductor, the filament is strained through an angle α until the resisting stress is equal and opposite to V. The strain αs, measured in centimeters, is the charge of the filament, and V is the potential of the charge. A positive current produces a positive charge; a negative current a negative charge; and the sum of two equal and opposite charges is evidently zero.

The laws of attraction and repulsion of charges are easily deduced from this hypothesis; and the laws of electrostatic induction become evident after a moment's thought.

In a condenser the resistance to twisting is removed from both ends of the short filaments between the plates, leaving only the resistance on the curved surface of the filaments. If the force, V, on the two ends be very great, the resistance to rotation may be overcome, the filaments whirl about rapidly, and relieve the strain by a spark discharge, in which the light is caused by vibrations of the disturbed atoms in the dielectric.

After a little thought the reader will be able to follow out the whole action of any ordinary induction machine, such as the Wimshurst.

IV.—MAGNETISM.

An electric current cannot rotate without some resistance or drag on the ether of the dielectric surrounding it. This drag or shear about the current is magnetism. A magnetic body allows this shear to take place more easily than in air, a diamagnetic body less easily. With the convention already made regarding a positive current, the ether displacement in a magnet is toward the north-seeking pole. All the well-known laws of magnetism and

electro-magnetic induction are easily and simply deduced from this hypothesis; and some curious phenomena, which are unexplainable on the ordinary theory, become clear with the aid of this theory.

The Central London Underground Railway.

The most recent addition to the system of underground railways with which London is provided, and the most important of all the present undertakings of a similar character in the world—the Central London Railway (Underground)—has an especial interest for Americans. This is due to the fact that the entire system of electrical equipment will be American. With the exception of the elevators the entire electrical contract has been assumed by the British Thomson-Houston Company, Ltd., representing in Great Britain the General Electric Company, of Schenectady, while the elevator contract has been secured by Mr. Frank J. Sprague, of New York.

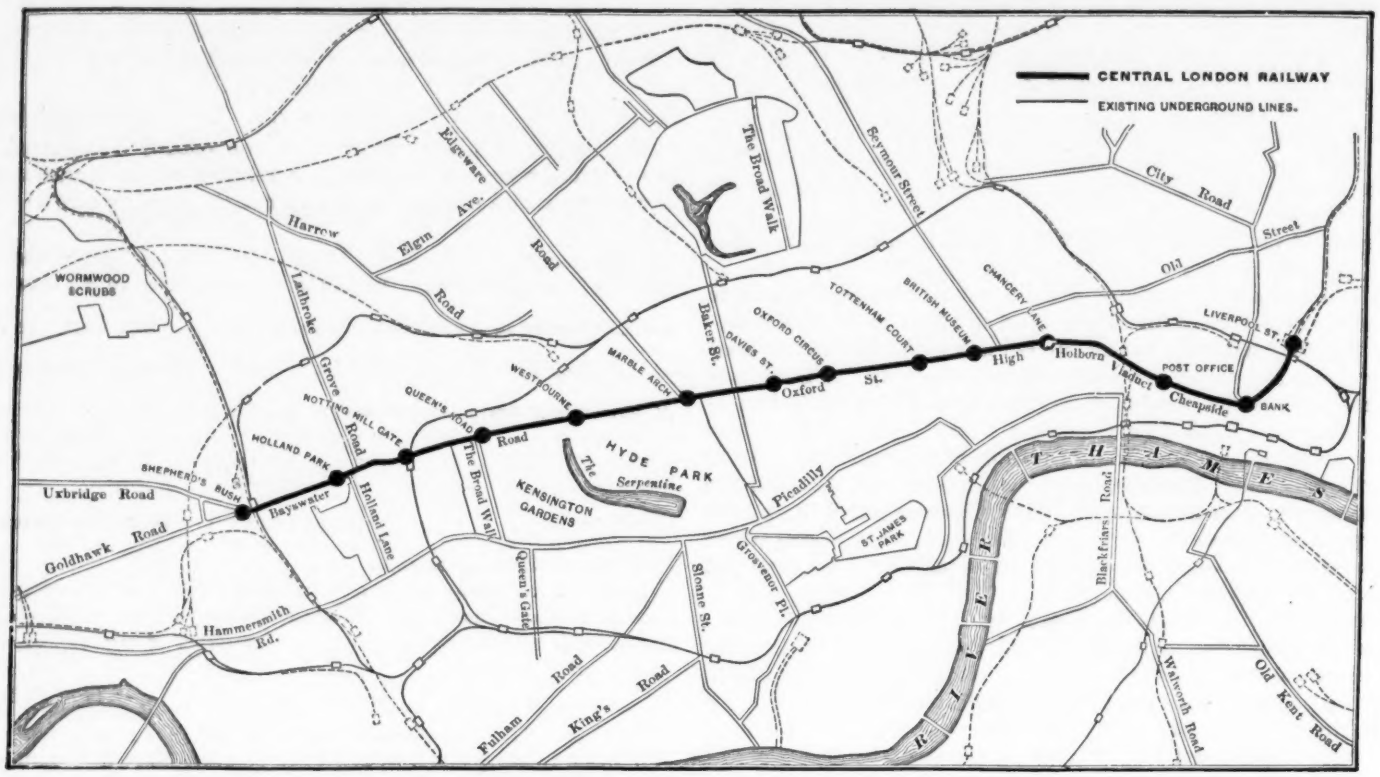
The road laid in two deep subway tunnels, driven by the Greathead shield, stretches from Liverpool Street beneath the station of the Great Eastern Railway Company, near Broad Street, the city terminus of the North London Railway, and the Bishopsgate Street station of the Metropolitan Underground Railway, through the very centre of the great commercial district of the city, and runs due west under Holborn, High Holborn, Oxford Street and past Hyde Park as far as the generating station located at the terminus at Shepherd's Bush. It follows the line of greatest traffic in London. The road will receive passengers from the great underground central depot, now in course of construction by the Central Railway Company, between the Bank of England and the Royal Exchange, and passengers brought in by the main lines of the London & Northwestern, Midland and London & Southwestern railroads. It is especially at this point in the city that crossing is a perilous task, and the railroad company is now engaged in constructing a series of subways immediately below the surface for the convenience of pedestrians and as approaches to its own station below. From this central depot will radiate not less than five underground tunnels, some 85 feet below the surface, each feeding a separate and equally populous district of the great agglomeration known as London.

The construction of the road itself has been carried out by the Electric Traction Company, which has also financed it. It is this company that has made the contracts with the British Thomson-Houston Company, and which will turn over the road fully equipped and in working order to the Central London Underground Railway Company ready for operation.

It was not until three years after the necessary parliamentary act was passed in 1893 that the actual work of building this road could be undertaken. Vertical shafts were driven at six different points to a depth of between 60 feet and 70 feet, and the tunnelling was begun in four tunnels at once, two running in each direction from the shaft. At each of the stations were driven two shafts 23 feet in diameter and 87 feet deep, and one 18 feet in diameter and 76 feet deep—the two former containing two ingress and two exit elevators and the two smaller two spiral stairways, one for ascending, the other for descending passengers. The shafts are built up of cast-iron plates 1⅛ inches thick and 4½ inches in the flanges. All crevices in the back of the plates are filled with hydraulic lime grout injected under pressure.

The glazed white brick passages leading from the bottom of the shafts to the stations are 8 feet 3 inches wide on the entrance side. On the exit side, where crowds might collect in front of the elevators, they are 13 feet wide.

At the stations the widened tunnel is 21 feet in diameter and 375 feet long. The main tunnels are each 11 feet 6 inches in diameter, and are practically steel tubes driven forward through the



MAP OF THE LONDON CENTRAL UNDERGROUND ELECTRIC RAILROAD.

clay. The plates used to line these tunnels are seven-eighths inch thick with flanges 4 inches deep. The shield for driving the small tunnels was 12 feet 8 inches in diameter, and was pushed forward by six hydraulic rams, giving a pressure of 230 tons. For driving the station tunnels the shield was 23 feet 8 inches in diameter, and was pushed forward by twenty-two rams giving a pressure of 840 tons.

Each tunnel will contain one track, one tunnel carrying the east-bound trains, the other the west-bound trains.

In laying the roadbed, the best modern steam railway practice has been followed. The steel rails weigh 100 pounds to the yard and are laid upon heavy cross ties. The system of contact will be the third rail, with the contact rail placed between the service rails of the track and insulated. The conductors will be fed at intervals from a copper feeder cable. This feeding will be controlled from the signal boxes, and the operator will be able to cut out any section of the line when necessary. This method of contact is similar to that employed so successfully by the General Electric Company in the installations on the East Weymouth, Nantasket Beach and Berlin-Hartford branches of the New York, New Haven & Hartford Railroad. The method of traction, however, will differ radically from that used on the branches above mentioned. Instead of passenger-carrying motor cars, with the motors mounted on the forward axle, locomotives similar in appearance to those used on the Belt Line Tunnel service of the Baltimore & Ohio will be

used to haul the trains. The reason for this lies in the fact that the tunnel is only 11½ feet in diameter, and that the bottom of the tunnel must accommodate the roadbed. This materially reduces the clearance. The motors require to be suspended between 30-inch wheels, at least, to give the necessary clearance between them and the ground, and this fact has brought about the locomotive in place of the passenger motor car.

The total length of the road is 6½ miles, from the station at Shepherd's Bush to the Mansion House, or 13 miles of single track. There will be fourteen stations, including the termini, located at the following points running east from Shepherd's Bush: Holland Park, Notting Hill Gate, Queens Road, Westbourne Grove, Marble Arch, Marylebone Lane, Oxford Circus, Tottenham Court Road, the British Museum, Chancery Lane, Holborn Viaduct, the Mansion House and Liverpool Street. In designing the line a decided departure has been made in the arrangement of the station approaches. As the railway company is not embarrassed by any considerations of grade, as in the case of surface railroads, the plan was adopted of making the road act as an auxiliary to the operation of the trains as well as merely to carry them. On each side of each station is a three per cent. gradient rising on the approaching side and falling to the level of the road on the departing side. This unique method gives a retarding effect to all trains approaching the stations equivalent to the application of considerable braking power, while materially aiding in the acceleration of all trains as they leave the platforms. Furthermore, the saving in power necessary to secure the requisite rapid acceleration is by the adoption of this plan calculated to amount to about 33 per cent.

The schedule speed of the trains will be 14½ miles an hour, with stops at each station of 20 seconds. The trains will be run at first under a headway of two and a half minutes, which will be reduced as soon as the traffic demands to a headway of two minutes.

The generating station will be located in the open air at the extreme western end of the line near Shepherd's Bush station. In building this the most modern American methods will be followed. The steam will be supplied from Babcock & Wilcox boilers, and the engines, of which there will be six, will be horizontal Allis machines each of 1300 horse-power.

The electrical system adopted is the three-phase alternating high-voltage primary with reducing transformers and rotary converters, similar in general principle to that installed successfully by the General Electric Company for the roads between Lowell, Mass., and Nashua, N. H., and at Portland, Ore., between Niagara Falls and Buffalo, and on the line between Dublin and Dalkey, in Ireland.

The dynamos, of which there will be six, will each be directly driven by its own engine. These dynamos are of the newly developed rotating field and stationary armature type. Each will have a capacity of 850 kilowatts. The speed of revolution will be 94, the frequency 25 cycles, and the initial voltage 5000 volts. The total capacity of the power station will be 5100 kilowatts or 6800 horse-power.

From the switchboard the current is carried to the converter sub-stations, of which there are four. Two of these will contain seven step-down static transformers, six for service and one in reserve, each of 300-kw capacity, and two rotary converters each of 900-kw capacity. The other two stations will contain four 300-kw static transformers and one 900-kw rotary converter. In the transformers the voltage of the current will be reduced from 5000 volts to 330 volts alternating, at which pressure it will enter the alternating side of the rotary converters, issuing from the commutator side direct railway current at 500 volts. The spare transformers mentioned above will be put into service when the headway of the trains is reduced. The static transformers are of the air-blast type, the windings being cooled by air forced through them by a blower. The rotary converters will be similar in construction to those used at Niagara, Buffalo and Nashua.

The use of the sub-station method of electrical distribution ensures a uniform pressure throughout the entire length of the line. Fluctuation, therefore, which would materially interfere with the lighting of the station and trains, is reduced to a minimum. The limit of variation fixed by the Board of Trade, to the rules of which department all electrical installations in Great Britain must accord, is ten volts. With the method adopted in this installation the variation in pressure will not exceed three volts.

The locomotives will number thirty-five. Each will consist of a sheet-iron cab containing the controller, indicating instruments, air brake, pump and controller, sand boxes, etc., mounted upon a locomotive truck. The motors have been especially designed for this work. They are of the gearless type and according to the new system of motor nomenclature adopted by the General Electric Company are known as the G. E. 56. Four of these motor will be mounted on each locomotive, one to each axle, the total draw-bar pull being 14,000 pounds. The controllers will be of the series parallel type arranged for four motors. Each controller will embody the magnetic blow-out principle.

The weight of each locomotive complete will be 35 tons of 2240 pounds. The trains will be made up of seven cars weighing when loaded 105 tons additional, giving a total train weight of 140 long tons. The seating capacity is calculated at 336 persons.

Access to and exit from the stations will be effected by means of powerful high-speed elevators. These will also be of American manufacture, and will be built by the Sprague Electric Elevator Company, of New York. The elevators will be forty-nine in number, each with a capacity of 15,000 pounds, or about 100 passengers per trip. The speed of elevation will be about 150 feet per minute. These elevators will be of the double-drum type similar to those built for the War Department at Washington, but of much higher carrying capacity.

It is estimated that the number of passengers that this road will carry per annum is 48,000,000, which at an average fare of 4 cents will give an ample return to ensure dividends upon the capital stock.

Current for the Manufacture of Aluminum.

The Pittsburg Reduction Company, which is engaged in the manufacture of aluminum, has two plants at Niagara Falls, one of which receives current from the Niagara Falls Power Company, and the other from the Niagara Falls Hydraulic Power & Manufacturing Company. The former plant, located a short distance from the power house, consumes about 3500 horse-power, delivered at the generators, of which about 3000 horse-power is available as direct current from the rotary transformers. These deliver current at a pressure of about 100 volts, which is sufficient to operate sixty retorts in series. The retorts are carbon-lined pots containing heavy carbon cylinders or rods which act as anodes, the pots being the cathodes. A mixture of alumina, fluoride of aluminum and fluoride of calcium is placed in the pots, and under the action of the intense heat combined with electrolysis, aluminum is deposited in the bottom of the pots, and is removed daily. The operation is a continuous one, the only interruptions being accidental.

The rotary transformers are six in number and receive their current from twelve static transformers operated by the 2200-volt two-phase current from the large generators. The high tension cables bringing this in are of 950,000 circular mils cross section, rubber-insulated and lead-covered, and laid in a subway from the main power house to the Pittsburg Reduction Company's works. At the static transformers the 2200-volt current is reduced to 115 volts, and after passing through the rotary converters, to 160 volts direct current, at which pressure it is delivered to the enormous copper bus bars, shown in the illustration. The cables between the static transformers and the rotaries are of 1,500,000 circular mils cross section. The total capacity of the rotary transformers is over 20,000 amperes.

The second plant of the aluminum company is located on the bank of the Niagara River just below the Falls, and just above the power house of the Niagara Hydraulic Power & Manufacturing Company. The generating plant of this company contains four turbines working under a head of 210 feet. The penstocks, which come down the cliff from the hydraulic canal at the top, are made of mild steel nearly an inch thick, with double riveted lap joints, this construction being necessary by the enormous pressure of the water under this great head. The turbines were constructed by James Leffel & Co, Springfield, Ohio, and each is direct-connected to two dynamos, one at each end of its shaft. Three of these sets of 1700 horse-power each are used for generating current for the Pittsburg Reduction Company, while the remaining turbine of 1900 horse-power, generates current for the Gorge railroad, and for other purposes. There is no transformation of the current in this case, direct current at 280 volts being used. This current is conveyed from the power house up the bank to the re-

duction plant by two conductors, each of which is composed of 250 number .00 aluminum wires. The conductivity of ordinary commercially pure aluminum is from 64 to 65 per cent. that of copper, while its weight is less than half for equal conducting capacity. At the present price of aluminum, its cost is a trifle less than that of copper for the same current-carrying capacity. These considerations, in connection with its lightness and the difficulty of anchoring the very heavy conducting cables leading up the cliff, led to the use of aluminum. At the reducing plant on the bank the conducting line is constructed of aluminum bars twelve inches wide and one inch thick. At the generators, the current is received upon copper bus bars ten inches by three-fourths inch in cross section. The production of aluminum has increased enormously. In 1883 only eighty-three pounds of this metal were made in the United States, while in 1894, the product was 550,000 pounds. This single plant has a capacity of nearly four million pounds per year.

The Interruption of Submarine Telegraph Cables by Electric Tramway Currents.

The Institution of Electrical Engineers in London has given more serious attention to electric tramway matters during the past few weeks than ever before. A paper by Mr. A. K. Baylor was devoted to improvements effected in electric traction appliances since that branch of the electrical industry was set on foot, and of necessity dealt chiefly with American practice. A more or less lengthy discussion followed, in which some of the leading English and one or two American traction experts took part. This was followed by another paper by Mr. J. S. Raworth, on "The Generation of Electricity for Tramway Purposes." The author, in his usual happy style, drew a fascinating picture of what he considered possible in reduced generating costs, where combined lighting and traction plants were efficiently operated. After Mr. Raworth's paper had been treated in discussion, the institution was favored with an important contribution by Mr. Alex. P. Trotter (formerly editor of the London "Electrician," and now electrician to the Government of Cape Colony), on the disturbance of submarine cables by electric tramways. It is seldom any one paper can interest both submarine telegraph cable men and electric tramway engineers, but this one was important to both bodies, especially as it was a subject which has had little, if any, consideration bestowed upon it previously. Submarine cables are easily affected and interrupted, and the various causes of these disturbances receive a great deal of attention from cable experts, but the consideration that a submarine cable should be affected by the current from an electric tramway on shore is a subject possessing a novelty all its own. Mr. Trotter presented his hearers with some interesting particulars as to the effect of the Cape Town electrical current upon a submarine telegraph cable of the Eastern & South African Telegraph Company, this cable being laid in a loop round Table Bay in order to avoid anchorages, and landed at the foot of Adderley Street at a cable hut. The first mile of the cable is laid at a mean distance of about half a mile from the Cape Town electric tramway, which was opened on August 6, 1896, the cars running from the boundary of the suburb of Mowbray to the corner of Darling Street and Adderley Street. The rails are eighty-one pounds to the yard, and are doubly bonded with Chicago bonds, except between Adderley Street and the tramway works, where the track is double and the rails are triple bonded. A test made on September 2 showed that the fall of volts on the rails was from half a volt to about one volt. From two to three-tenths of an ampere passed between the earth plates and the dynamos. There are two earth plates, but by mistake only one wire was brought from them. A test made between the earth plates and the feed service of the boilers showed that two volts caused 2.5 amperes to pass. The works are about 1.25 miles from Adderley Street. Mr. Trotter states that as soon as the tramway service began, the working of the siphon recorder was found to be seriously disturbed. Numerous "kicks" occurred, and these being superimposed on the received signals made it difficult and often impossible to decipher them. It was found when a car started from the terminus of the tramways, which was within view from the cable company's window, that simultaneously with the movement of the handle of the controller a "kick" was recorded on the slip. Mr. Trotter thought that the disturbance might be due to the direct leakage of current, owing to the use of earth as a return by the tramway, or to induction owing to the proximity of the cable, and that the first might be removed by the use of an earth at a considerable distance, and the second by an equal and opposite induction. A series of experiments were instituted, a number of earths being tried, but no reduction of the disturbance was found, and, on the whole, the ordinary earth on the sheath gave the best results. The nature of the disturbances is described by Mr. Trotter. The cable was sometimes connected to Mossamedes, the length being 1383.526 knots, and the resistance 8820 ohms. It was sometimes put through to Loanda, 530 knots up the coast. It is worked with thirty-five cells and a condenser of sixty microfarads. The resistance of the coil of the recorder is 500 ohms. In sending it is shunted with one ohm. No disturbances are perceived during sending, but in receiving it is sometimes shunted with 6000 ohms. The "kicks" occurring were of various amplitudes, depending upon the current which happened to be passing at the moment of breaking. One kind of disturbance was a comparatively small and irregular quiver of the line, and was probably due to the jumping of the trolley at insulators and points, and perhaps to sand on the rails. Attempts to reduce the disturbances by means of earths being of no avail, Mr. Trotter attempted to apply an equal and opposite induction. A private telephone line from Cape Town to Mowbray, which had been rendered almost useless on account of the disturbances, as it ran alongside the tramway for two and one-half miles, was used for the purpose. The line was earthed at Mowbray, and was connected through the usual condenser of sixty microfarads with the siphon recorder at the cable office, and was earthed on to the sheath of the cable. At the same time another recorder at the cable hut was connected also through the usual condensers, to the core and sheath of the cable. The instruments were run simultaneously, the time was marked at every ten minutes on each slip, and these were afterwards compared. Every disturbance of the cable was clearly reproduced on the telephone line, with an amplitude about five times greater. Not a single kick on the cable failed to be represented also on the telephone line; but many of the smaller ones on the telephone line were not visible on the cable slip on account of the small amplitude. Various other experiments were carried on for some time by Mr. Trotter and others, and on September 15 Mr. Trotter reported to the Postmaster-General upon the results of the experiments, and summarized the five courses which might be adopted, as follows:

(1) Make a remote earth connection by means of a telegraph line. (This has been so far unsuccessful).
(2) Neutralize. (This has also been unsuccessful).
(3) Prevent all leakage. (This is impracticable).
(4) Reduce abruptness of change of current. This is recommended if 1 and 2 fail.
(5) A last resort, but a sure one, says Mr. Trotter, is to lay a few miles of new two-core cable across the bay.

The experiments were continued by others, including Mr. N. Shaw, but it is understood they were not successful. A further section of the tramways was opened in October, and the increased traffic resulted in a marked increase in the number and amplitude of the disturbances. The operators had begun to read the signals in spite of the kicks, but after this the signals were almost always illegible while the trams were running. The amplitude was greater on some days than others, but this variation could not be traced to changes of weather, and the author thought it might be due to heavy traffic only.

The proposed new cable was laid in January, this year. The sheath and core were connected to the instrument at the cable hut, and kicks in all respects similar to those of the old cable were witnessed. An earth plate was attached to the end of the new cable, and to the great satisfaction of those present a nearly continuous line was drawn by the siphon. A few kicks of rather less than one millimeter were visible. The length of the new cable is about five knots, and it was laid as nearly as possible over the old one. Since the last experiment the traffic has been resumed, and no appreciable disturbances have been noticed.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Thickness of the Sheet Metal Used in Alternating-Current Apparatus. LOPPE. *L'Eclairage Elec.*, June 12.—A reprint of a recent paper. The loss per unit of volume of iron and the thickness of the insulation between the sheets being given, there is a certain thickness of metal which is the best; this he discusses by a graphical method, finding curves with a point of inflection. Assuming a loss of 15 watts per cu. dcm. and a thickness of insulation of 0.07 mm he obtains in this way a thickness of 0.4 mm, the maximum induction being 3900; to show that this thickness varies very little he deduces similar curves for a loss of 20 watts and for 10 watts, obtaining the figures 0.39 and 0.41 mm. He then discusses the effect of the frequency, calculating for a loss of 15 watts per cu. dcm. the maximum values of the induction and the corresponding thicknesses for different thicknesses of insulation and different Steinmetz coefficients, the results being given in a table. To show that it is of no use to reduce the thickness to less than 0.4 mm he takes the most unfavorable case and gives the results in a table.

Mordey Winding. SAYERS. Lond. *Elec.*, June 18.—A short communication supplementary to the discussion of Mordey's recent paper. Dividing the four-turn coil in the machine mentioned in the paper into two equal parts distinct from each other reduces the self-induction to a half, while half the conductors would be available for commutating power; thus the ratio of the commutating power to the self-induction remains the same, but there will be an advantage in Mordey's arrangement, as the leading horn will be stronger. He does not agree with Mavor or Atkinson to the effect that the same result would be obtained by bringing the pole tips very near together; he mentions but does not describe a perfect form of reversing pole for use in his machines, by means of which the reversing field is strictly proportional to the load on the armature.

Predetermination of the Excitation at Full Load. DICK. *Elek. Zeit.*, June 17.—A brief description of what appears to be a comparatively simple analytical method for calculating the excitation at full load, that at no load being easily calculated with considerable approximation by the well-known methods; the formulas are given in tabulated form; an apparently simple graphical method is also given; with this method it may be easily determined in advance whether the loss of voltage due to the armature reaction can or cannot be compensated. He has applied the method to a number of machines and obtained good agreement in most cases.

Slot-Wound Dynamo.—Lond. *Elec.*, June 18.—An illustrated description of a 110-kw continuous-current machine made by Easton, Anderson and Goolden, including an efficiency curve.

Rotary Transformers. ROUTIN. *L'Eclairage Elec.*, June 12.—A short mathematical article in which he deduces rational formulas for the effective value of the alternating current in the form of single, two and three phase, by rotary transformers operated by a continuous current.

The Rotary Converter. STEINMETZ. *Sib. Jour.*, June.—A reprint of a long lecture giving an interesting discussion of the theory of such machines, from which he draws a number of important practical conclusions; it appears to be the best article on this subject which has recently appeared; some of the more important deductions are given here briefly. In such machines the alternating and continuous current pass through the same armature and their respective voltages therefore have a definite relation; in most cases additional step-down transformers will therefore be necessary; he compares rotary converters with a combination of a motor and a generator, the former requiring transformers and the latter also between 10,000 and 1000 to 6000 volts; in reliability of operation and first cost a single machine is preferable; the rotary converter with transformers will give an average efficiency of 90.7 per cent., a direct-current generator, synchronous motor and transformers 82.5 per cent., and without transformers 84.6 per cent.; the rotary converter has the advantage that no transference of mechanical energy takes place. The theory is briefly discussed and formulas are given for calculating the voltage and current when two, three and four equally distant points are connected to as many collector rings; a table gives the alternating voltages and currents using the continuous voltage and current as a unit; this is given for single, 3, 4, 6, 12 and n phases. The question of armature resistance and heating is discussed, and he shows that for the same energy loss in the armature the current in the rotary converter can be increased in a certain proportion over that of the direct current generator; on this basis, the figure for a continuous current generator being 1, the figure for a single phase is 0.85, three phase 1.34, four phase 1.64, and for infinity phases (that is, as many collector rings as there are commutator segments, thus forming the LeBlanc rectifier) 2.31. The armature reaction is the resultant of the generator and motor action and it is therefore equal to zero; that is, there is no armature reaction except that due to the small amount of energy to rotate the machine; there is no magnetic reaction if the current is in phase with the impressed voltage; the armature reaction is demagnetizing with a leading, and magnetizing with a lagging current; with a lagging current the field magnetization must be lower and with a leading one higher than for coincidence of phases; by increasing the field excitation a leading current, or by lowering it a lagging current can be produced; with a leading current the self-induction of transformers and lines supplying the rotary converters increases and with a lagging current reduces, the voltage below that corresponding to a non-inductive load; thus the field excitation offers a means of controlling and even of raising the voltage with the load; the increase of field strength with increasing load is insignificant compared with that of the same machine used as a direct-current generator; owing to the absence of distortion a much greater armature reaction can safely be used in rotary converters; the field excitation can be varied through a wide range without noticeably affecting the voltage at the commutator brushes; with high armature reaction and relatively weak fields a full and overload can be carried without any field excitation whatever; that is, by exciting the field by the armature reaction of the lagging alternating current; such converters without field excitation are similar in construction in their magnetic fields, but allow no control of the alternating system, cannot be compounded, and must be run with a lagging current; the polyphase converter is self-starting, running up to complete synchronism, which is indicated by beats in a lamp or volt meter; the field circuit must be opened at starting; the starting is essentially a hysteresis effect; excessive voltages may be induced in the field, reaching frequently 4,000 to 6,000 volts which must be taken care of; when synchronism is reached the field circuit is closed and the load put on; while starting the continuous side must be open; polyphase rotary converters can also be used as generators delivering continuous or alternating currents; the armature reactions are then additional and the field excitation or compounding is the sum of the compounding due to the continuous and alternating currents generated; in general such use of the alternator is undesirable; when the rotary transformer is used to transform from direct to alternating currents, the armature reactions equalize each other, but attention must be paid to the nature of the alternating load on the machine; when a heavy inductive load is put on suddenly the converter will rapidly speed up the more the lag of the load increases, and when not checked by strengthening the field excitation the acceleration may be serious. Most of the preceding discussion applies only to polyphase converters; in single-phase rotary converters the continuous-current and synchronous-motor armature reactions do not neutralize each other, as the latter pulsates with double the frequency; thus the armature polarization oscillates, giving a very unfavorable condition for sparkless commutation and making the continuous current pulsating; the single-phase converter is not self-starting; it is preferable, therefore, in general to use direct-current generators driven by alternating-current motors instead of single phase converters.

Electrical Machine Shop Practice. HOBART. *Elec. Eng.*, June 23.—The beginning of a series of articles in which he intends to give a description of special shop practice as found in the shops, together with improvements in the existing methods. The question of armatures and their assembling is discussed in detail, with illustrations.

Making and Repairing Commutators. SHARPE. *Amer. Mach.*, June 24.—A brief illustrated description of a method which he uses for making and repairing a repair shop commutator.

LIGHTS AND LIGHTING.

Alternating-Current Arc Lamps. CLAUDE. *L'Eclairage Elec.*, June 12; an abstract of a recent paper read before the International Society.—A difficulty encountered in the regulation of alternating current arc lamps is that the variable self-induction of the electromagnet affects the regulating current so that it is no longer proportional to the increased resistance of the arc; he shows that the intensity of the regulation current increases only one-fifth as rapidly as the resistance of the arc. To overcome this he suggests placing in series with the regulating electromagnet a condenser of suitable capacity, in which case the intensity of the regulating current would not only increase proportionately with the resistance

of the arc, but even more rapidly if the capacity is suitably chosen; if it increases too rapidly a spring may be used as a counter force. The ordinary objections to condensers do not apply, owing to the small difference of potential; the dimensions of such a condenser may be reduced to 10 cm in diameter and 3 cm in thickness, and it can therefore be put in the lamp case.

Artistic Lighting.—Lond. *Elec.*, June 18.—Illustrated description of the lighting effects in a small plant at a restaurant in Glasgow.

POWER.

Power Distribution at Sandycroft.—Lond. *Elec. Rev.*, June 18.—An illustrated description of the plant in the Sandycroft foundry; accumulators are used, and among other things there is a crane on which a magnet is used for holding fast to castings to be lifted.

Transmission of Power in Factories. CLIREHUGH. Lond. *Elec.*, June 18, in abstract and *Elec. Eng.*, June 18, in full.—A publication of the discussion of his paper which was noticed in the *Digest*, June 5; it appears to contain nothing of importance.

Water Driven Plants. MURPHY. *Canadian Elec. News*, June.—A reprint of a short paper read before the Canadian Electrical Association. He calls attention to the importance of regulation; he advocates supplying light and power from separate water wheels respectively and using a separately driven exciter; he calls attention to an automatic speed indicator and alarm, and an apparatus for closing the water gates when the speed increases.

TRACTION.

True and False Economy in Light Railway Construction. PAIN. Lond. *Elec. Eng.*, June 18.—A reprint of a short paper read before the Institution of Civil Engineers. He shows the importance of going around instead of over hills, to provide numerous stations and sidings, to limit the speed, etc.; he points out the saving by using a narrow gauge.

Alternating Current for Street Railway Service.—St. Ry. Rev., June 15.—The beginning of an article of an elementary nature, giving a brief insight into the subject of alternating currents, with special reference to their use for power purposes. As it is of an elementary nature and appears to contain nothing new no further reference to subsequent portions will be given.

Commercial Aspect of Electric Railways. CARR. *Canadian Elec. News*, June.—A reprint of a short paper read before the Canadian Electrical Association; he gives hints as to the best method of construction, equipment and operation.

Cast-Welded Joint. MEAD. *Wisconsin Engineer*, July.—An illustrated description of the joint used by the Chicago City Railway Company.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capital Outlay, Receipts and Expenditures for the Statutory Stations in London and the Provinces for 1896.—Lond. *Elec.*, June 18.—A supplement in the form of a large folded table, giving analytical data, compiled apparently from the Board of Trade accounts as far as they are available; additional data will be added to this as soon as it is published by the Board of Trade. No general summaries are given; in an editorial reference attention is called to the fact that in the space of three months the market value of shares of certain of the metropolitan companies has increased 24 per cent., and that these all happen to be continuous-current stations. During the past year the capital expenditure for these four latter London companies increased about 14.5 per cent. and their output 28.5 per cent.; in 1895 the capital outlay per unit sold amounted to 75 cents, and in 1896 this was reduced to 68 cents. The cost of coal per unit sold was 1.36 cents in 1895 and 1.28 cents in 1896. In the 10 municipal stations in the Provinces the average capital expenditure per unit sold is 87 cents.

Budapest Polyphase Station. JEHL. Lond. *Elec.*, June 18.—An illustrated description, with ground plans and interior view, of this station, which is one of the oldest polyphase stations for the combined supply of polyphase power for motors and continuous current for lamps, from the same generators; a two-phase current with a frequency of 25 at 1800 volts is used; the continuous current supply is from a three-wire net work, fed from three sub-stations having rotary transformers, two of them having accumulators; the efficiency of the entire system is 67 per cent.

Best Means of Preventing Leakage. WALKER. Lond. *Elec. Eng.*, June 18.—The conclusion of his article (see *Digest*, last week); it appears to contain nothing of importance; his conclusions are that the best precaution is a general care throughout, both in designing and laying, with a liberal allowance for insulation and cross-sectional area; repeated tests should be made.

Automatic Interrupter for High Tension Circuits.—L'Ind. Elec., June 10.—An illustrated description of an apparatus for making and breaking a circuit at a distance; it consists of a balanced lever made to move in one or the other direction by a current from a small battery making or breaking the high-tension current by simultaneously closing and opening a succession of breaks in series between platinum and mercury.

Wright Indicator. BOISTEL. *L'Ind. Elec.*, June 10.—An illustrated description of this well-known indicator, preceded by a discussion of the rational methods of charging for current.

Why Some Lighting Plants Do Not Pay. ARMSTRONG. *Canadian Elec. News*, June.—A reprint of a paper read before the Canadian Electrical Association. He assumes that a plant is a paying investment when it earns 12 per cent. or over on the capital invested; he assumes 6 per cent. as a full return for the money invested, the other 6 per cent. being a sufficient allowance for depreciation; he then points out a number of causes of failure, among them being the personnel of the management, the question of rates, cutting them down to increase the business, and the question of motors.

Accumulators in Lighting and Power Stations. JOHNSON. *St. Ry. Rev.*, June 15, and *Canadian Elec. News*, June.—A reprint of a short article read before the Canadian Electrical Association. He points out the advantages of a battery of accumulators; a list is given of eight companies in America which have large batteries; also the working results of a plant, showing the saving accompanying the use of the accumulator.

How to Select an Electric Plant. WHITE-FRASER. *Canadian Elec. News*, June.—A short paper giving some hints and discussing briefly the questions of direct *vs.* alternating-current systems, the best size of the plant, etc.

The Steam End of an Electric Plant. WICKENS. *St. Ry. Rev.*, June 15, and *Canadian Elec. News*, June.—A reprint of a paper read before the Canadian Electrical Association.

Day Load for Central Stations. KAMMERER. *Canadian Elec. News*, June.—A reprint of a short paper read before the Canadian Electrical Association. He calls attention to the importance of day loads, and advocates changing a single into a multiphase alternating-current system in order to be able to supply motive power.

Philadelphia.—West. Elec., June 26.—A short abstract of the report of the city electrician, Walker.

WIRES, WIRING AND CONDUITS.

Plain vs. Insulated Pipe. ZINGLER. Lond. *Elec. Rev.*, June 18.—A reply to the article by Bathhurst (see *Digest*, last week), and defending his own position; the price list referred to is identical with one just received; several errors made by Bathhurst are pointed out; if the same wire must be used for both plain and insulated pipe then he questions the use of the insulated lining.

Overhead Lines. MONTPELLIER. *L'Elec.*, June 12.—A continuation of his article. He describes the Boucherie process of injecting a solution of sulphate of copper into the pores of the wood; the life of such a pole is about 15 years.

Economy in Circuits. KEELEY. *Canadian Electrical News*, June.—A reprint of a paper read before the Canadian Electrical Association. He gives a diagram of a modified form of circuit for supplying lamps distributed approximately in the form of a hollow rectangle, from transformers, and shows that without exceeding the weight of copper or drop of voltage in the single-parallel system it is possible with his system to provide for distribution with an equalized pressure at all points. Instead of one transformer he uses two of half the size; one of the feeders begins at the negative pole of one of these, passes in the form of a loop to the negative terminal of the second transformer; a similar loop, but reversed in the direction in which it passes around the rectangle, is connected with its ends to the two positive terminals; the lamps are connected at various points between these two feeders; the mains or feeders are half the size which they would be if the ordinary method were used.

ELECTRO-PHYSICS AND MAGNETISM.

Action of the Electric Field on an Incandescent Lamp. HOFFMAN. *Elek. Zeit.*, June 10; noticed briefly from a German journal.—When an incandescent lamp with current passing through the filament is brought near a vacuum discharge tube it will be noticed that a force is exerted on the filament; for slow intermittent discharges it will oscillate, and for rapid ones it will take a definite position; it is thought to be due to an influence action; there is a decided difference when the filament is nearer the anode than the cathode, the force being much greater in the former case.

Polar Differences in Tesla Currents. PFLUEGER. *Elek. Zeit.*, June 10; abstracted from the *Wied. Ann.*, 60, p. 768.—The two poles of a Tesla coil have a decided difference in their action, so much so that reversing the current in the primary reverses the phenomenon; this is especially the case if one of them is connected to a point and the other to a disc; the differences are shown still more clearly if Röntgen-ray tubes with only one electrode are connected to one of the terminals; there will be a much greater generation of X-rays when it is connected to that pole, which, in the former experiments was the less active; that is, when it had more the character of the cathode.

Discharges. SWYNGEDAUW. *L'Eclairage Elec.*, June 12.—The conclusion of his long paper. The principal conclusions are as follows: The frequency of the sparks, the state of polish of the poles, ultra-violet light and X-rays, all exert a different action on the static than on the dynamic sparking voltages, thus justifying the distinction that he makes between

the two; in the usual process of determining the critical distance the sparking dynamic voltage is, in general, different from the sparking static voltage; one may be greater, less or equal to the other, according to accidental conditions of the experiment; using the precautions which he indicates, the critical distance may be determined with precision; the discharge is more regular; the equality of the static and the dynamic sparking voltages is thus justified by experiment.

Discharge Voltages from Points in Air and Hydrogen. WESENDOCK. *L'Eclairage Elec.*, June 12.—A French translation of the article noticed in the *Digest*, May 8.

Oscillating Charge of Condensers. TALLQVIST. *L'Eclairage Elec.*, June 12.—A French translation of the article noticed in the *Digest*, May 8.

Loss of Electricity from a Conductor in Air. OBERBECK. *L'Eclairage Elec.*, June 12; abstracted from the *Wied. Ann.*, 607, p. 193.—He discusses the loss of voltage from a conductor in air and the effect on this phenomena of an increase of temperature in the conductor.

Hall Effect in Bismuth. VAN EVERDINGEN. Lond. *Elec.*, June 18; abstracted from a Holland publication. He endeavored to prove experimentally the mathematical explanation of Lebret based on the supposition that in a magnetic field the resistance of bismuth increases by different amounts and in different directions with respect to the axis.

Resistivity of Platinum at Low Temperatures.—L'Ind. Elec., June 10; abstracted from the *Wied. Ann.*, 59, p. 213.—The results of experimental determinations made by Holborn and Wien with the aid of liquified air.

Anticipation of Zeeman's Discovery. VAN AUBEL. Lond. *Elec.*, June 18; abstracted from a Holland journal.—In a letter to the Amsterdam Academy he shows that some of Zeeman's results were obtained in 1886 by Fievez and were published in the Bulletin of the Belgian Academy; the latter found that the emission spectra are modified in a magnetic field in a manner analogous to that due to a change of temperature; that the lines are broadened and that they are sometimes reversed and doubly reversed; it seems doubtful whether his observed effects are really due to magnetic action and not to change of temperature.

Influence of the Magnetic Field on Radiation Frequency. LODGE and DAVIES. Lond. *Elec.*, June 18.—A reprint of a short Royal Society paper, describing an additional observation, and supplementary to the former paper of Lodge on Zeeman's discovery; a concave Rowland grating was used.

Cathode and Anode Rays. MALTEZOS. *L'Ind. Elec.*, June 10.—Reprints of two Academy notes, in one of which he describes various phenomena showing attraction when the finger is approached to the tube and another in which there is an electromagnetic action between the cathode rays and a wire carrying current; he shows that the surface of the cathode is not the most energetic centre of the rays; in the second he shows that there is an anti-anodic action analogous to the anti-cathodic and that there exist under certain conditions anode rays which produce visible and invisible phosphorescence on the glass and which generally diffuse or do not arrive at the glass. The second paper is also published in *L'Eclairage Elec.*, June 12.

X-Rays. GALITZIN and KARNOJITZKY.—Lond. *Elec.*, June 18; noticed briefly from the memoirs of the St. Petersburg Academy, 3, No. 6. (It appears that this paper was published last year).—They endeavor to find the source of the X-rays by means of the shadows of nails driven into a board; the results agree with those obtained by other methods (but what they are is not stated in the abstract). With plates of tourmaline results showing polarization almost beyond a doubt were obtained.

Ionisation and Physical Properties. MACGREGOR. Lond. *Elec.*, June; noticed briefly from the *Trans. Nova Scotian Inst. of Science*, 9, p. 219.—He attempts to build up the physical properties of a solution from its state of ionisation.

Röntgen-Ray Diffusion Phenomena. ELIHU THOMSON. *Elec. Eng.*, June 23.—An article describing experiments with diffusion. It is well known that many substances will diffuse the X-rays received by them; in some substances there is a conversion of the energy of the rays into ordinary light, as for instance those substances which are used for fluorescent screens. He made the experiments with one of his tubes, in which the source is brought very close to the object; these rays are directed on to a lump, slab or mass of crystals or granules of the material to be tested, and they are then viewed at an angle through a blackened tube closed with a fluorescent screen; in this way diffusion was shown; he also showed a secondary diffusion, that is, a diffusion of the rays which have already been diffused once. He suggests that as calcium tungstate does not diffuse the rays but gives out light, it may be possible that there exist substances which absorb Röntgen rays and give out wave lengths above the visible rays; it is conceivable but not probable that substances also exist which emit rays below the red when submitted to X-ray radiation.

Recent Investigations with X-Rays. HALE. *Sc. Amer.*, June 19.—A description, more in detail and with illustrations, of some of the experiments of WRIGHT which were noticed in the *Digest*, May 29. He made experiments with refraction and polarization, but thus far obtained only negative results. In certain other pictures of platinum wires he obtained a very unexpected result which is claimed to be of great importance; the picture of the wire, which was scarcely as thick as a pin, appeared as a bright line which under the microscope showed a faint dark line through the centre or axis of the wire, which exactly corresponds to the bright interference lines caused by the defraction of light rays; this may be due either to defraction or to the deflection of streams of radiant matter; he is now investigating this subject. He also made experiments with gallstones enclosed in pieces of beef; they were all shown in the photographs, but with different degrees of distinctness.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Copper Sulphate. FOERSTER and SEIDEL. Lond. *Elec. Eng.*, June 18.—An extract from an article in a German chemical journal. Some of the results obtained by them are contradictory to those of Schuster; they state that copper is appreciably soluble in an acid sulphate solution protected from the air. Their conclusions are that electrolysis of copper sulphate with a small current density takes place in a certain way described in the abstract. The addition of alcohol eliminates some of the errors to a great extent; very small currents can be measured with fair accuracy in this way, provided a high current density is used; accurate results are also obtained by using an electrolyte saturated with cuprous ions obtained by electrolyzing a "2 N" solution with 0.1 ampere at 100° for a few hours. In the electrolytic refining of copper it is advantageous to heat the electrolyte to some extent.

Gold Extracting Process. CLARK. Lond. *Elec.*, June 18.—A short communication with some additional remarks regarding the Haycraft process mentioned in the *Digest*, April 3.

Electrolytic Conductivity of Solid Bodies. FRITSCH. *L'Eclairage Elec.*, June 12.—A French translation of the article noticed in the *Digest*, Mar. 27.

Electrolytic Decomposition of Chlorides of Sodium and Magnesium. BEEBE. *Wisconsin Engineer*, July.—A long abstract of a thesis. After discussing and describing briefly the several well-known processes, he gives the results of some experiments which were made to determine the most economical application of power, the cost of which in these processes is generally the determining factor; he determined the power required to produce hypochlorites from the electrolytic decomposition of magnesium and sodium chlorides; the effect of different current densities and the effect of the density of the electrolyte on the power required; the effect of temperature on the efficiency; also how strong a solution could be obtained economically. In some of these experiments a number of tanks were connected in series, there being some difference in each tank. The results of some of them are given in curves; his conclusions are of interest. He considers that his experiments justify the conclusions, which are briefly as follows: the amount of available chlorine in the solution is not proportional to the power expended; the available chlorine per ampere is chiefly dependent on the temperature of the electrolyte; it is dependent on the amount of the products of decomposition formed in the solution; at fairly high temperatures, 50° C., there may be an actual decrease in the available chlorine per ampere hour; the available chlorine per ampere hour depends largely on the density of the electrolyte, and dense solutions produced more than dilute ones; it is possible to obtain solutions having a high value of available chlorine; the effect of the current density on the efficiency cannot be stated definitely, as in some cases a high current density seems to be more efficient while in other cases it is the reverse; if the temperature gets below 15° C., a concentration of 9.7 per liter at an efficiency of 0.9 grams per ampere hour can be obtained with a solution of common salt of a density of 1100; with a Hermite or similar solution it is possible to obtain a concentration of 8.8 grams of available chlorine per liter at an efficiency of 0.58 grams per ampere hour; under the same conditions it is practical to obtain a concentration of 6.8 grams per liter and an efficiency of 0.7 grams per ampere hour; a dilute electrolyte disintegrates carbon anodes much more rapidly than a concentrated one; reversing the current frequently, as has often been proposed, greatly reduces the efficiency and is useless; the polarization for a given density of electrolyte and temperatures remains constant, regardless of the current density. In conclusion he gives a list of the more important articles which have appeared on this subject recently, together with their references.

Manufacture of Sodium Peroxide. DUNLAP. *Elec. Eng.*, June 23.—A brief illustrated description of the plant recently started at Niagara Falls. The electrical equipment consists of three 175-kw rotary transformers. In the process, which is only briefly described, caustic soda is reduced to metallic sodium and cast into bricks; this is converted into peroxide of sodium by placing it into small dishes which are passed through a furnace with dry air, which oxidizes the sodium into peroxide, a canary colored substance which is ground and shipped in that form; this material is gradually and surely taking the place of barium peroxide, both being used in the manufacture of hydrogen peroxide; it contains 12 times as much bleaching oxygen as the ordinary ten-volume hydrogen peroxide, and can be kept an indefinite time.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard Cells.—Elek. Zeit., June 17.—An extract from the report of the work of the Reichsanstalt for the past year in the *Zeit. f. Instrumentenkunde*, May. The tests with the cadmium cells were continued; the new cells agree with the old ones within one part in 10,000; the E. M. F. as compared with the Clark cells is 1.019 international volt, assuming 1.433 for the Clark cell at 15°. The irregular action of some cells at low temperature, was further investigated, the trouble appearing to be due to the for-

mation of a hydrate; heating to 40° corrected this; analogous results were found with the Clark cell; heating these to 60° brought these cells back, but at 0° they then had a 1 per cent. lower voltage; this shows the importance of care regarding heating in the construction of such cells; by inserting a small crystal, the normal condition was restored in an hour; the relation between the Clark at 0° and the cadmium at 20° was always the same within one-ten-thousandths and was found to be 1.4227 as compared with 1.4226 which was given previously; repeated tests showed that both the cells are reproduceable and constant within one part in 10,000. The relation of the Clark at 15° to the cadmium at 20° always gave the same result, which was 1.4066 with an uncertainty of one to two parts in 10,000. The temperature coefficient of the Clark cell was 0.0163 volt from 0° to 15°; between 10° and 30° the formula is E (at 15°)—0.00116 $(t-15)$—0.00001 $(t-15)^2$; in another formula which applies from 0° to 30° the above constants are 0.00119 and 0.000007.

Changing the Fundamental Units in the Absolute Systems. Malagoli. *L'Eclairage Elec.*, June 12.—An article discussing the choice of the units which are to be used as the fundamental in an absolute system of measurement. At present these fundamental units are length, mass and time; the two former are prime units, but the third is deduced from the movements of the earth; it would be better to select for the third a prime unit, such as force or work. He then deduces general equations for calculating the dimensions of any other system of fundamental units in terms of the present or vice versa, and shows how the dimensions of any quantity in terms of one system can be changed into those of a new system by means of a relatively simple calculation; with the aid of these formulas he calculates the new dimensions of physical quantities, in which he uses as the fundamental units the quantity of electricity, the quantity of magnetism and the unit of work or energy; these dimensions, as well as those of the usual system, are given in a table; with the units or physical quantities all the dimensions are expressed in whole numbers, that is, there are no fractional exponents; the larger number are expressed in terms of only two of the three fundamental units, that is, the larger number of the physical phenomena have relations which are expressed more simply in terms of these new units; other fundamental units were also considered, but none of them gave such simple results as these; there exists no system of units in terms of which the dimensions of physical quantities will have only whole numbers as exponents and positive at the same time.

Determining the Hysteresis Loss in Straight Iron Strips. Fleming. Lond. *Elec. Rev.* and *Elec. Eng.*, June 16.—An abstract of a Physical Society paper. Samples in the form of straight strips were inserted in a long solenoid traversed by an alternating current and a flat bobbin of fine wire was slid along the strip; the current in the former and the voltage in the latter were measured; assuming Steinmetz's law regarding the 1.6th power, he shows that there must be some point where the true mean hysteresis loss for the whole bar is proportional to a certain induction density which he calls the effective value; this point he calls the effective point; this effective value is then equal to the 1.6th root of the mean ordinate of the curve representing the varying values of the induction along the half length of the strip; he then found the interesting experimental result that "whatever be the length or section of the iron strip the point at which the actual induction density has a value equal to the effective value always comes at the same proportional distance from the centre of the strip. This distance is very exactly equal to 0.56 of the half length as measured from the middle, or 0.22 of the whole length from one end;" if therefore the secondary coil is placed at that spot and the secondary voltage observed is used to calculate the induction density, the values so obtained correspond to the true value of the varying hysteresis loss per cu.cm. all along the strip.

Standard Electrostatic Voltmeter. Perot and Fabry. *L'Eclairage Elec.*, June 12.—An abstract of a recent description read before the International Society. The instrument is based, like the electrometer of Kelvin, on the attraction of two parallel discs, the distance between which is made extremely small, several hundredths of a millimeter; they are formed of plates of glass silvered on one side; when charged they are brought back to the same distance by means of a spring, the deflection of which is read; the voltage is proportional to the square root of the force, but the reading is made direct by a mechanical arrangement; the distance between the plates is regulated by an optical method; by repeated reflections between the discs interference rings are produced and the adjustment is made until these rings are the same; the accuracy is one-tenth of a volt.

Registering Volt and Ammeters. Arnoux and Chauvin. *L'Eclairage Elec.*, June 12.—An abstract without illustrations of a description presented before the International Society; the instruments have already been described; the improvement in the present form is chiefly in the recording mechanism.

Thomson Bridge.—L'Eclairage Elec., June 12; from the *Annales Télégraphiques*, 22, p. 433.—An illustrated description of this bridge for measuring the resistance of telegraph wires.

Recording Tachometer. Jones. *Elec. Rev.*, June 23.—A brief illustrated description of a recording indicator of speeds. It consists simply of two telegraph sounders, into which pencil points have been fastened for writing on a band of paper; both write on the same band, which is drawn through by hand; in a middle there is a timing pencil which is pressed down by hand at any desired intervals; the circuits for the telegraph sounders are closed periodically through a simple contact on the revolving shaft whose speed is to be measured; a multipoint switch enables the instrument to be connected with any two of a number of different shafts in a station whose speed is to be determined; all the parts are easily constructed.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Synchronograph.—Elek. Zeit., June 17.—An editorial comment on the new American system of Crehore and Squier. It is admitted that the system is ingenious and novel, but it would be a mistake to conclude at present that the prospects are as great as those predicted by the inventors; the apparatus was merely in laboratory form and not in the form of a finished working model; in the Wheatstone rapid system the time-constant of the line is even at moderate distances larger than the time-constant of the apparatus; 600 words can be sent when the two are coupled together, while with 500 km of copper line the speed is already reduced to 100 words per minute; it is therefore not so much the lowering of the time-constant as it is to devise an apparatus which requires as small a current as possible, for the smaller this current the more rapid will be the signals; whether the present apparatus is superior to the Wheatstone in this respect does not appear. The handling of the apparatus involves very great complications; the short exposure requires an exceedingly sensitive photographic film; the whole process becomes so complicated that its practical application can hardly be considered; furthermore, two parallel lines operated on this system would have a very decided effect on each other.

Effect of Sea Water on Induction Telegraphy. Whitehead. Lond. *Elec. Rev.* and *Elec. Eng.*, June 18.—An abstract of a Physical Society paper. He investigated mathematically the effect of the conductivity of the sea water in transmitting messages by induction from a fixed coil to a movable vessel. In the discussion Evershed said that the formula gave too low an estimate of the attenuation, when the results are compared with those which he obtained by experiment; Yule doubted whether the equations were quite applicable; Heaviside thought there was no reason why the conductivity should interfere with the signalling; also that Maxwell's method was sufficient.

Polarized Telephone Receiver. Giltay. *Elek. Zeit.*, June 10.—A translation from the proceedings of a society in Amsterdam. In their previous paper, read 13 years ago, he showed that a condenser without a charging battery, or a telephone without a permanent magnet, will reproduce the tones an octave higher; at present microphones are greatly improved over those used in 1883; he repeated the experiments and obtained the same results with a certain condenser; he also found that some condensers can be used without a charging battery; the experience with other condensers is also described and it appears that different results were obtained, and that they were also different, depending on what sounds were transmitted. In conclusion he describes what he calls an electro-dynamic telephone, in which no iron whatsoever is used; it consists of a coil of wire, which is wound loosely and is mounted as usual on a telephone handle like in the ordinary telephone, except that there is no iron core; the front is covered with a disc of mica; the wires must be wound loosely; when current is passed the action will be to set these wires into vibration, as they will attract each other; this attraction is proportional to the square of the current; such a coil will produce a note an octave higher; if the coil is furthermore traversed by a current from a battery it will reproduce the original note and the octave will be of less intensity; they used a charging battery of 30 Leclanche cells; no general conclusions are drawn.

Iron Telegraph Poles. Dubreuil. *L'Eclairage Elec.*, June 12; reprinted from the *Annales Telegraphiques*, 22, p. 385.—A long, profusely illustrated description of the system of poles and supports used in the Eastern colonies of France; the poles are of T cross-section, as this reduces the labor in making the attachments; they are mounted in a column of concrete; the cost per kilometer ready for stringing the wires is $59, there being 14 poles to the kilometer; a line of wooden poles would cost $22.8, but their maintenance would cost $6.4 per km per year, as compared with $0.60 for iron poles; in the course of seven years therefore the wooden poles will have cost more.

Hughes vs. Common Type of Relay. Finn. *Teleg. Age*, June 16.—A discussion of the relative merits of these two relays for single circuit working; he concludes that the peculiar properties of the Hughes type which makes it so valuable under suitable conditions, cannot be advantageously applied to our present methods of operating single Morse circuits.

Climbers for Iron Poles. Glassford. *Elec. Eng.*, June 23.—An illustrated description of the pole climbers which are used on the iron pole military lines in the western part of the country.

Terminal Cable Huts.—Teleg. Age, June 16.—A reprint, with the illustration, of the short description noticed in the *Digest*, June 5.

MISCELLANEOUS.

Lightning Rods.—Elek. Zeit., June 10.—An editorial giving a summary of a recent lengthy and important discussion at the German Society, the full report of which is to be published in that journal in the course of several weeks. The results of the discussion are considered to be very important, giving a new insight into the subject; if the conclusions are to be accepted, and it is thought there is no mistake in accepting them, there will be a complete revolution in the technic of the lightning rod. Formerly

it was thought that a lightning rod had two functions, one, a preventive, consisting in equalizing the charges of the clouds and the earth, thereby preventing a bolt of lightning, and the other to form a path of low resistance for a bolt of lightning. Experience is said to have shown that lightning rods have only the second function and that there are no facts to substantiate the belief that they have a preventive action; if this is true, there is no need of having fine points on lightning rods nor to be very careful to keep the resistance low, nor to have a carefully prepared earth plate; all that remains necessary to do will be to have a path from the top of the house to the earth which has a resistance appreciably less than that of the building; the careful preparation of joints would then be unnecessary; the claim often made that a poor lightning rod is worse than none, is therefore quite incorrect, as the simplest form of lightning rod will offer some protection.

Soldering Iron.—Elek. Zeit., June 10.—A brief description of a form devised by Wieczoreck. The end of the iron is made of a round bar of copper held in a suitable frame at the end of a tubular handle lined with another insulating tube, inside of which is a movable carbon rod which may be adjusted from the end of the handle; the current passes from the carbon to the copper block forming an internal arc which heats the latter; it is said to be very cheap.

Electricity at the Cape.—Lond. *Elec.*, June 18.—A full abstract of the report by the government electrician, Trotter. He reports on the work done, on the government laboratory and on the rules regarding meters.

German Union of Electrical Engineers.—Lond. *Elec. Eng.*, June 18.—The beginning of a report of the annual meeting at Eisenach; none of the papers are abstracted; a brief description of a small plant is given.

Prize.—L'Ind. Elec., June 10.—A note announcing that the Ferraris prize, which has been subscribed by the public, will be offered for the most important industrial application of electric energy which will be exhibited at the International Italian Exhibition.

Electrically Welded Steel Barrels.—Eng. News, June 24.—A paragraph stating that in a factory at Uxbridge, England, barrels are made at the rate of 240 a week, in which the seams are electrically welded by the Bernados process; the barrels are used chiefly for storing lubricating and lighting oils. A description of the process was noticed in the *Digest* several years ago.

Canadian Electrical Association.—Canadian Elec. News, June.—A very full account of the proceedings of the seventh convention at Niagara Falls; a number of the papers read are reprinted in full in the same issue; those referring to electrical subjects are noticed in the *Digest* under their specific headings.

An Automatic System of Telegraphy.

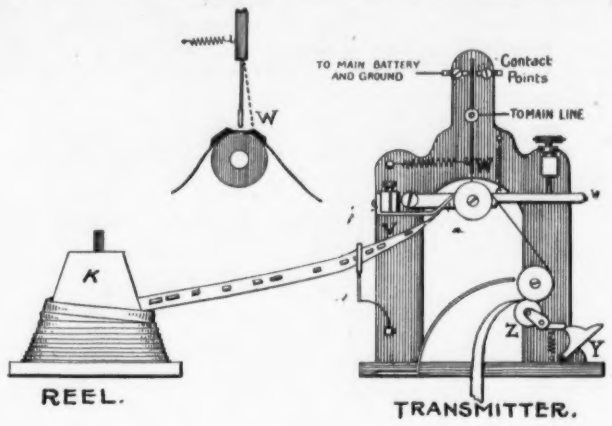
Since the advent of the telegraph many attempts have been made to transmit accurately and rapidly from embossed or indented tape, but the results have been far from satisfactory and nothing has come from the various efforts, except, perhaps, that each has taught a lesson.

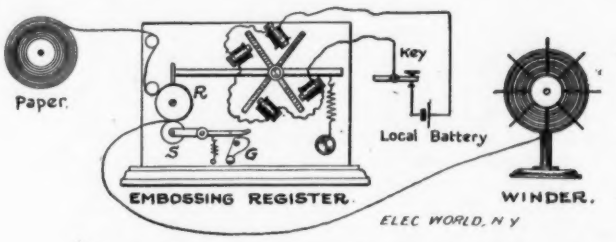
In the beginning the idea was to transmit by an up-and-down motion of an arm having an electric contact, the arm, of course, being controlled by the embossments or indentations. It would seem that proper consideration was not given to the peculiar formation of an embossed or indented dot or dash and in the operation the signals were mutilated and not clear cut, the arm not being positive and regular in its action.

In the Weiny-Phillips system these difficulties have been overcome and their transmitter is abundantly able to reproduce at almost any speed whatever is put upon the tape.

In embossing running tape there is at the beginning of each dot or dash an incline, and at the end a decline caused by the entrance and withdrawal of the embossing or indenting stylus. It is these angular ends that have proven so troublesome, preventing a quick make and break contact. In the illustration *W* shows the angle at which the embossments approach and leave the transmitter arm, the dotted line indicating the arm leaving one embossment, with an uninterrupted path to return to its normal position. It does not therefore have to slide down the declining portion of the embossment until the frictional contact is weakened enough to permit the retractile spring to do its work. This transmitter arm is a straight, almost rigid, bar that yields only in the direction in which tape is running, and is always clear of the unindented portions of the tape, thus preventing scratching or grinding at the electric contact-points.

The lever *Y* on the transmitter controls the press wheel *Z*, which of course starts or stops the tape as desired. Reel *K* is a cone-shaped wheel upon which is placed the tape ready for transmission, and is so made that it permits of unrolling the tape from the centre. The embossing register is substantially the same as the old-style stylus recording register, except that the magnets are arranged to better advantage and permit of the balancing of the armature. The armature carries a three-pointed stylus to guard against flaws in the tape, the stylus striking the wheel *R* just to the right of the centre, in order to secure abrupt ends to the embossments. The apparatus is operated in this manner: An operator takes his dispatches to an embosser, which is in a local circuit, and by throwing lever *G* press wheel *S* engages the tape and starts it moving, and he proceeds to transmit the messages. As fast as the tape is prepared it is wound into a roll by the winder. It is evident that the first message sent is nearest to the core of the winder, and for this reason it is desirable to begin the automatic transmission from the centre. It was this point that suggested the cone-shaped reel in order to secure this result. As soon as the winder is full, or it is desired to transmit what has been prepared, the roll is taken from the winder and placed on the reel. The inner end is then passed through the transmitter and the record is started on its journey. At the receiving end the relay controls an embossing register which records the incoming dots and





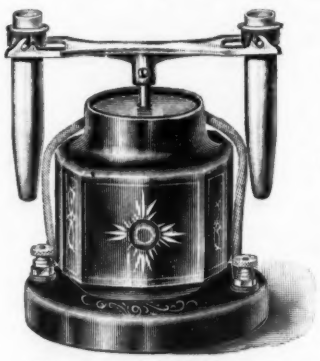
DIAGRAMS OF AUTOMATIC TELEGRAPH APPARATUS.

dashes. The tape thus received is led to a slow-running transmitter with a sounder in local circuit, and is run at any rate the transcribing operator desires. The dispatches may be coming over the main line at a speed of 60 or 80 words per minute rate, while the transcribing operator on the local transmitter may be reading it at a 15 or 20 words per minute rate, the surplus being stored on the tape.

The embossing receiving instrument is precisely the same as that shown, being, however, operated directly by the main line relay instead of by the key. The arrangement shown is for the purpose of embossing the tape preparatory to its transmission. This system is the joint invention of Mr. R. H. Weiny and Mr. Walter P. Phillips, of New York City.

An Electrical Centrifuge.

We illustrate herewith the Heiman electrical centrifuge, recently brought out by the Edison Manufacturing Company, New York, which is claimed to be far superior to the hand centrifuge in the investigation of blood, bacteria, etc., in virtue of the regular speed which it is possible to obtain, and which is very essential where accurate, uniform results are desired.



ELECTRICAL CENTRIFUGE.

The machine consists of an iron-clad motor, the armature of which runs in a horizontal plane. The lower end of the armature shaft is set in a jeweled bearing in order to reduce the friction, while the upper extremity projecting beyond the body of the motor is arranged to carry either a urine attachment or a hæmatocrite, used in examination of the blood. The former consists of a rigid cross arm carrying at each extremity a simple socket for holding a tapered metallic shield, which is capable of assuming a horizontal position and into which a glass tube graduated into tenths of a cubic centimeter is inserted. The hæmatocrite, which may be substituted for the urine attachment, consists of a metallic frame carrying two accurately graduated glass capillary tubes seated in rubber cushions and held securely in place by a spring.

The centrifuge is so arranged as to be run on either a 110 or 120-volt direct-current circuit, a 52 or 104-volt alternating-current circuit or by Edison-Lalande batteries. A suitable rheostat is furnished to control the speed.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 28, 1897.

ELECTRICAL STOCKS.—No marked changes in quotations were noticeable in this list at the close of last week, quietness seeming to be the prevailing condition. Edison Electric Illuminating of Brooklyn closed 1¼ points lower, and Edison of New York receded ½ point, the sales of the latter amounting to 125 shares. Electric Storage Battery is a little stronger and closed the week with a net advance of 1 point for the common, while the preferred stock advanced 1¾. General Electric shows a net increase of ¼ point, the sales of the week amounting to 3,772 shares. General Electric Preferred formed the exception to the general list in the matter of strength, advancing 6 points. In the bond list, Edison Illuminating of New York con. 5's show an advance, and General Electric debentures closed the week ¾ better than the last quotation.

TELEGRAPH AND TELEPHONE.—Quietness prevailed in these stocks and no noteworthy changes are recorded. American Telegraph & Cable improved slightly, gaining 2 points, and Western Union advanced 1 point, the sales of the latter stock for the week amounting to 34,417 shares.

ELECTRIC TRACTIONS.—Brooklyn Rapid Transit showed some activity during the past week and advanced 2¼ points, the sales amounting to 14,718 shares. Buffalo Street Railway is 1 point higher, while most of the other stocks in this list lost fractional amounts.

WESTINGHOUSE COMPANY'S ANNUAL REPORT.—The Westinghouse Electric & Manufacturing Company, on Tuesday, June 22, declared a quarterly dividend on its preferred stock of 1¾ per cent. The annual report for the year ending March 31 last shows assets, $17,965,295, of which $1,647,751 were bills and accounts receivable, $1,636,612 material on hand, and $4,689,081 charters, franchises and patents. The bills and accounts payable amounted to $691,685. The report says that a reduction in the surplus account of $1,577,735.93 is due to writing off bad debts, disbandment of old factories, obsolete machinery, etc. On June 4 an increase in the capital stock from $10,000,000 to $15,000,000 was authorized, and $3,000,000 of the new stock was sold to the Security Investment Company, of Pittsburg, for $2,489,000, of which $1,260,000 was in cash and the remainder in property and secured notes; $347,419 was expended during the year for the purchase of new patents and plants. Under the contract with the General Electric Company the company has bought for $216,600 the Tesla patents for multiphase-current motors, and both companies will make them. Also for $72,231, the capital stock of the R. D. Nuttall Company, and for $58,500, the company bought certain patents. The wisdom of the deal with General Electric has been fully established. Patents of the company are carried at $4,689,080, or less than 37½ per cent. of the aggregate book value of the patents of both companies. Stocks, bonds and properties appear on the books at cost. There has been no market for the sale of stocks and bonds of lighting companies for two years. The combined companies, the report says, have control of the power-transmission apparatus used in this country.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	115	117
Edison Electric Ill., Brooklyn	100	107	109⅛
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	21½	22
Electric Storage, pref	100	23¼	24
General Electric	100	33¼	33½
General Electric, pref.	100	74	76
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref	50	50	51

BONDS.

Edison Electric Ill., New York, con. 5s	105	114¼	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	99½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	230	231
American District Telegraph	100	..	85
American Telegraph and Cable	100	92	94
Central and South American Telegraph	100	124	127
Commercial Cables	100	168	..
Erie Telephone	100	65	66
New England Telephone	100	104	104½
Postal Telegraph Cable	100	100	..
Western Union Telegraph	100	84	84¼

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18⅞	19
Brooklyn Rapid Transit	..	26⅜	26¾
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	69	71
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	43
Hestonville	100	50	51
Hestonville, pref	..	.	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	28	30
North Shore Traction	100	22	24
North Shore Traction, pref	100	80	82
Rochester Street Railway	..	10	13
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	84⅜	84½
West End, Boston, pref	100	91¼	92
Worcester Traction	100	14	16
Worcester Traction, pref	100	90	93

BONDS.

Brooklyn Rapid Transit 5s, 1945	100	80½	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	105	107
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD.
253 Broadway, NEW YORK, July 1, 1897.

INCREASING ITS CAPITAL STOCK.—The Amsterdam Electric Light, Heat & Power Company, Brooklyn, N. Y., has called a special meeting of stockholders, to be held July 14 next, to discuss the proposed increase in the capital stock from $500,000 to $1,000,000. This is the company that recently purchased the State Electric Light Company, and it proposes to make further extensions.

CORNELL UNIVERSITY ELECTRICAL SOCIETY.—We are in receipt of a copy of the proceedings of the Electrical Society of Cornell University for 1896-97. Among the contents are articles on "Electricity on Shipboard," by W. F. Durand; "Interaction Between Armature and Field," by H. H. Norris; "Electric Station Design," by I. J. Macomber; "Use of Accumulators in Central Station Practice," by C. H. Sharp; "Interpretation of Dynamo Characteristics," by H. J. Hotchkiss; and "Electrical Waves and Oscillation," by Ernest Merritt.

COUNTING AND CHARGING OF CABLE MESSAGES.—Mr. George G. Ward, vice-president and general manager of the Commercial Cable Company, is sending out notices to the effect that on and after July 1 the rules for counting and charging cable messages will be modified to meet the changes agreed upon by the International Telegraph Convention, held at Budapest, in 1896. The instructions given in this circular are very clearly stated, and a copy of the same should be in the hands of everyone using the cable for the transaction of international business.

SAILED FOR HOME.—Messrs. Arthur Wright and Henry Reason, of Brighton, England, and Mr. William L. Madgen, of London, who are interested in the Wright demand meter system, sailed on the "Normannia" today. These gentlemen have been in the United States for several months in the interests of their meter system, and were all present at the recent Niagara Falls Convention of the National Electric Light Association. They expressed themselves as being much delighted with things American, and report that the indications for favorable business are very good.

BULLETIN CATALOGUES.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, and New York, has made a new departure in cataloguing its various electrical machinery. It now issues bulletins at regular intervals, each separate bulletin being descriptive of some particular type of machine and its application. Some of these bulletins have already come to hand. They are gotten up in exceedingly artistic fashion, the descriptive matter and illustrations being of the highest class. They unquestionably embody many details which are not generally found in such literature.

CONDUIT PERMIT GRANTED.—The Board of Electrical Control has granted to the United States Government, in accordance with the instructions of the Corporation Counsel, a permit to lay a conduit across Wall Street, connecting the Custom House with the Sub-Treasury. This is the work over which there was some legal difficulty recently. It was claimed that the Government had no right to build the conduit on account of the right having been granted to the Subway Company. The matter, however, was decided in favor of the United States Government, as above noted.

WHEN DOES THE DANGEROUS SPEED BEGIN?—Justice Van Wart, of the Lee Avenue Civil Court, Brooklyn, has recently decided against the surface railway companies in the suits brought by the city against them for operating their cars at a rate of speed above that fixed by a Brooklyn ordinance. This decision was appealed to the County Court, and Justice Hurd reversed the decision of the lower court. The city again appealed to the Supreme Court, whose opinion has not yet been handed in. Counsel for the companies claim that the city must prove that running above ten miles an hour is dangerous.

THE TICKER SERVICE.—The contract between the Western Union Telegraph Company and the Stock Exchange, according to which the former obtains various stock quotations and distributes them through the Gold & Stock Telegraph Company's ticker system, expired on June 30. The ticker service, however, was not discontinued, although a new agreement is under consideration, which will probably be in such terms as to prevent the quotations from going to the bucket shops. The ticker service will not in any way be interrupted pending the new arrangements. The details of the latter have not as yet been made public.

MUNICIPAL AFFAIRS.—In the June number of "Municipal Affairs," Mr. Allen R. Foote gives an article, entitled "No Government Should Operate an Industry." This paper was written at the request of the Committee on Municipal Administration of the Reform Club, of New York, in reply to a paper under the title, "New York City Should Own the Gas Supply," written on a similar request from the club, by Mr. Grout. Mr. Foote's opinions in matters of this nature are well known to the electrical fraternity, and it is needless to say that he makes a strong argument in support of his contention that no Government should operate an industry.

TO DETERMINE THE ANTIQUITY OF EGGS BY ELECTRIC LIGHT.—The universal application of the electric current and its important position in our daily life is again exemplified in the recent organization of the Independent Egg Inspectors' Union, who have applied to the Central Labor Federation for a charter. It is said that these egg inspectors are experts of the highest order, and can at a glance detect the innermost thoughts of the most deceptive egg. They were formerly known as egg candlers, because eggs were formerly tested by holding them between a candle flame and the eye, but a recent decision of the union is to the effect that the candle must go and the electric light be generally adopted for this purpose.

TO ABANDON FOREIGN BUSINESS.—It is stated that the International Bell Telephone Company is making preparations to discontinue its foreign business. This concern introduced the telephone into several foreign countries, the principal one being Russia, where it has a twenty-one-year contract with the Government. This contract will expire in 1901. Meantime, it is stated that the company is selling its other business in Sweden, Holland, Switzerland and Belgium. The officers think they will be able to pay the stockholders in full out of the proceeds of these sales and the earnings in the next few years. The company at one time had a capital of $1,750,000. This was reduced to $1,000,000, and has just been further reduced to $750,000, by the payment to the stockholders of a cash dividend of $250,000.

TROLLEY CARS ON THE BRIDGE.—A new set of trolley plans for crossing the Brooklyn Bridge has been submitted to Chief Engineer C. C. Martin. This makes the third set prepared by the engineers of the Brooklyn Heights Railroad, which has had charge of the matter for the combined surface railroads of Brooklyn seeking the privilege. The new plans do away with the supporting post, which was outside the jurisdiction of the bridge trustees, and for which, it seems, the trolley companies could not obtain the consent of the Manhattan Elevated Railroad Company and Mr. Ottendorfer, of the New York "Staats-Zeitung." The new plan will provide for a cantilever loop at the New York terminal of the bridge. This loop will go over the Manhattan Elevated station at that point.

STAGE-LIGHTING APPARATUS.—Mr. J. Carl Mayrhofer, the well-known electrical engineer and specialist in theatre lighting and effects, has now a well-equipped office and laboratory at No. 28 Centre Street. At this place Mr. Mayrhofer has a complete line of apparatus devised by himself, which is especially adapted for stage illumination and effects, and whose practical success has already been demonstrated in a number of highly successful metropolitan productions. Mr. Mayrhofer's experience extends over a period of almost twenty years, during which time he has given his entire attention to electrical stage effects and lighting. Some of the apparatus which he now has on exhibition is exceedingly interesting and novel. A catalogue is shortly to be issued, embodying descriptions of all the various appliances and, judging from the advance copies, it will show devices and apparatus somewhat new and distinct from any ordinarily seen in the practical electrical field.

MR. STERN'S TELEPHONE.—Mr. Simon Stern, who two years ago obtained an injunction against the Metropolitan Telephone & Telegraph Company, enjoining it from increasing from $150 to $240 a year the rental for the telephone used in his office, is still in possession of the instrument and paying the old rate. The preliminary injunction was appealed from and the order was vacated, but on June 25, Justice Parker, in the Appellate Division, restored it. In his opinion, Justice Parker holds that on issues as passed by the pleadings, the facts as to profits and cost of operation have an important bearing, and that the plaintiff was not obliged to wait until the trial to examine the defendant officers, for they are non-residents, and possibly could not be subpoenaed for the trial. Mr. Stern's course of action was based on the fact that the defendant company, which enjoys the monopoly of a public franchise, like a common carrier, can charge only reasonable rates for its service. In order to show that the telephone business under the new tariff would yield exorbitant profits, he obtained ex parte, an order to examine the defendant's officers before a referee, and for the production and inspection of some of the defendant's books.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., June 30, 1897.

TWO RESIGNATIONS.—Mr. Henry Lewis, formerly superintendent of construction, and Mr. A. W. Rose, chief electrician, of the Standard Telephone Company, Philadelphia, have severed their connection with that company, dating from June 30, after having served in the above capacities for the past year.

ENLARGED ITS FACILITIES.—The Quaker City Electric Company, Philadelphia, Pa., has considerably enlarged its shop in order to accommodate its increasing business. Its old office on Carter Street has been thrown into the shop, and a new office and showroom has been opened at 237 and 239 Dock Street, where the company will take pleasure in showing the public its improved motors, dynamos, etc.

A STATUE TO BEN FRANKLIN.—A $10,000 statue of Ben Franklin is to be erected in front of the Post Office in this city, on the historic spot where the great philosopher sent up his kite to capture the lightning from the sky. It was on this same spot that he afterward laid the corner-stone of the old University of Pennsylvania Buildings. The statue will be of heroic proportions, and it is to be paid for Mr. Justus C. Strawbridge. It will be designed by a Philadelphia sculptor named John J. Boyle.

ELECTRICAL ENGINEERING AT DREXEL INSTITUTE.—The Drexel Institute of Art, Science and Industry, Philadelphia, Pa., has just issued a pamphlet, describing the course of electrical engineering at that Institute, which course is in charge of Prof. Arthur J. Rowland. The course of instruction and training occupies three years, and includes a wide range of subjects. Laboratory work runs parallel with the lectures and instruction. The Institute has a well-equipped laboratory. From October 1 to March 31 there are held evening classes in applied electricity.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., June 28, 1897.

CONSOLIDATION OF ELECTRIC RAILWAYS.—At a meeting held Monday last the directors of the Olean, Rock City & Bradford Electric Railway Company decided to consolidate the New York and Pennsylvania ends of the road under one management. The road is now completed between Bradford and Rock City. It is expected that cars will be running between Olean and Bradford by the middle of July.

THE PAN-AMERICAN EXPOSITION.—Captain Brinker, the promoter of the great Pan-American Exposition, which will be held on Cayuga Island, Niagara River, May 1, 1899, has announced that the whole of the machinery connected with the exhibit will be run by electricity. He says that restaurant keepers will have their places equipped with electrical-cooking apparatus only; that every building will be completely fitted out with electrical-heating plants, and that not a single smokestack or boiler will be allowed within the grounds.

G. A. R. ILLUMINATIONS.—If the plans at present under consideration by the Encampment Committee mature, the electrical illumination of Buffalo during G. A. R. week will be the finest ever seen. It is expected that there will be enough electrical displays along Main Street to make night seem like day. Two elaborate plans for electrical arches have been submitted by local artists, and these are now under consideration by the committee. At the suggestion of an electrical expert from New York, the merchants along the street who have their own electric power will be asked to provide displays.

PITTSBURG NOTES.

PITTSBURG, Pa., June 28, 1897.

ANOTHER NICE ORDER FOR THE WESTINGHOUSE INTERESTS.—It is announced that the Boston Terminal Railway Company has awarded recently to the Union Switch & Signal Company, of Swissvale, Pa., the largest contract ever received by the latter company. The order is for the complete equipment of the Boston Terminal Company's lines with electrical and pneumatic inter-locking switches and block signals, and will amount, it is said, to $120,000 in the aggregate.

CONSOLIDATION COMPLETED.—On June 26, at meetings held by the stockholders of the Pittsburg, Allegheny & Manchester, the Second Avenue and the North Side Traction Companies, there was consummated the much-talked-of deal between these companies and the Union Traction Company, of Pittsburg. It was almost unanimously voted at these meetings to sell all the property and franchises of the respective companies to the Union Traction Company, which was formed for the purpose of effecting this consolidation. It has a capital stock of $10,000,000, of which $7,000,000 is common and $3,000,000 is preferred stock. It is authorized to issue bonds to the amount of $10,000,000,

and these will be 100-year 5 per cent. gold bonds. The price paid for the Manchester road is $1,500,000 in cash and $960,000 in bonds, which Brown & Sons hold the right to take within six months at par. The 60,000 shares of stock will be taken up at $41 per share, $25 in cash and $16 in bonds.

ANNUAL MEETING OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—On Wednesday, June 23, the annual meeting of the stockholders took place at the factory of the company in East Pittsburg, Pa. The annual report of the company was read, showing the condition of the company to be a prosperous one. The same directors of last year were re-elected; they are: August Belmont, Lemuel Bannister, Geo. Hebard, Henry B. Hyde, Marcellus Hartley, A. M. Byers, N. W. Bumstead, Chas. Francis Adams, Brayton Ives and George Westinghouse, Jr. After the meeting the announcement was made to the stockholders that the St. Lawrence Construction Company, of New York, had, on June 19, awarded to the company a contract for fifteen 5000-hp generators, which are to be erected at its plant at Massena, N. Y. This is the largest single order ever given for electrical apparatus, and the amount directly involved is about three-quarters of a million dollars. This contract, together with that recently given by the Cataract Construction Company, for five 5000-hp generators for installation at Niagara Falls, N. Y., makes a total of twenty 5000-hp generators, having a total capacity of 100,000 horse-power, which have been ordered from the Westinghouse Electric & Manufacturing Company this year. The five generators for Niagara Falls are well under construction, and the other fifteen required by the St. Lawrence Company will be immediately proceeded with. Their construction will give employment to a large number of men. These orders cover only the apparatus for generating electricity, and there will necessarily be required other apparatus of equal capacity for the utilization of the electrical energy produced by these great generators. The Westinghouse officials expect that a large proportion of the additional apparatus will be ordered from their company, on account of their having already secured the contract for the principal apparatus. The placing of these recent important contracts has undoubtedly resulted by reason of the great success of the three 5000-hp generators already installed at Niagara Falls.

Cleveland Notes.

CLEVELAND, O. June 28, 1897.

ELECTION OF OFFICERS.—The stockholders of the Cleveland Telephone Company held their annual meeting last Thursday afternoon. The old officers and Board of Directors were re-elected.

PROPOSITION FROM PITTSBURG.—The Electrical Specialty Company, of Pittsburg, offers to locate in Youngstown, Ohio, if ten acres of land are given it. The Board of Commerce is trying to secure the land.

WORK BEGUN.—Work on the Elyria and Oberlin electric line was commenced last week on Middle Avenue. The power house will be located on East Broad Street, Elyria, Ohio, and will soon be ready for occupancy. The company promises to have cars running early in September.

MORE CONDUITS.—The Home Telephone Company, which opened its exchange early last spring with about 600 'phones in service, has a large force of men putting in conduits in all of the downtown streets. More telephones are being put into service continually, and it is the company's intention to have its system in operation in all the suburban districts early this coming fall.

LOWER FARES.—An agitation is on foot with the object of having the two city railway companies adopt a cheap rate of fare to all the parks. The plan is believed to be thoroughly practical, and it is thought that the companies would do a larger business on that basis than at the present rate of fare. The superintendents of each company declare that it would be impossible to operate under any lower rate of fare than the present charge.

AN ELECTRIC PLANT.—The Euclid Beach Park Company, owners of a large pleasure resort eight miles east of Cleveland, has just installed its own electric plant. The power house plant consists of an Erie City Company's automatic engine and horizontal tubular boiler, belted to a General Electric generator; capacity, 80 horse-power. The grounds are wired for both arc and incandescent lights, and it is also intended to furnish power to operate motors for use on the grounds. The Electric Supply & Manufacturing Company installed the plant, the Victor Electrical Company furnishing the generator.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., June 28 1897.

TO EQUIP ITS LINES WITH ELECTRICITY.—The stockholders of the Alley Elevated Railroad Company have voted to authorize an issue of $1,500,000 of 4½ per cent. bonds for the electrical equipment of the line. One-half of the issue will be offered to the public at par.

MR. MASON'S NEW POSITION.—Mr. W. R. Mason, the well-known electric railway supply man, has been appointed selling agent for the State of Missouri for the Walker Company, Cleveland, Ohio. Mr. Mason's office will be in St. Louis, in which city he has already established his headquarters. The Walker Company may be congratulated on securing the services of so able a representative in the Southwestern territory.

VISITORS IN CHICAGO.—Among the callers at the offices of THE ELECTRICAL WORLD during the week were the following named gentlemen: Mr. T. R. Mercein, secretary and general manager of the Milwaukee Auxiliary Fire Alarm Company; Mr. M. M. Hayden, general manager of the Globe Carbon Company, Ravenna, Ohio, and Mr. William Davis Barnard, Eastern representative for the Western Telephone Construction Company. Mr. Mercein's visit in Chicago is of a business nature. Mr. Barnard came West to attend the Detroit telephone convention. His popularity was evident by the number of representative telephone people that crowded around to shake hands and welcome him again to Western soil.

CONSOLIDATION OF THE CHICAGO CABLE LINES.—On Wednesday afternoon, June 23, the Illinois Supreme Court nullified the quo warranto proceedings against the General Electric Railway Company by former Attorney-General Moloney, thus leaving the franchise of the General Electric Railway Company flawless. A consolidation of the surface railway systems under the name of the Chicago Traction Company, therefore, now seems assured. It is stated that the Chicago City Railway Company has refused to sanction the deal. It is also reported that besides the consolidation of the cable lines, it is proposed to unify the elevated roads of this city. Mr. C. T. Yerkes has outlined a plan having this object in view, and it is stated that these lines will probably agree to Mr. Yerkes' plan.

A FINE EVENING'S ENJOYMENT.—On Friday evening, June 25, the members of the Chicago Electrical Association, accompanied by lady friends, accepted the hospitality of Mr. W. A. Harding, of the Calumet Electric Railway Company, in the form of an illuminated and spectacular trolley ride over the lines of that company. The evening was particularly fine, the preparations for transportation, illumination and entertainment were entirely complete, and the temper of the gathering was as full of vivacity as is usual with technical aggregations. At the close of the trip, after four hours' condensed enjoyment, vociferous cheers were given Mr. Harding and the Calumet Electric Railway Company, with a finale for the association itself.

CHICAGO SCHOOL OF ELECTRICITY BICYCLE RACE.—A 5-mile bicycle race between the members of the Chicago School of Electricity was run at the Garfield Park track on Thursday, June 24. It was an enjoyable event, and attended with much friendly rivalry between the contestants. The sprint was hotly contested, and Bruns and Hatch, who worked hard for second place, crossed the tape almost simultaneously, Bruns having the lead. The winners were: H. Almert, 1; R. E. Bruns, 2; C. E. Hatch, 3; and A. Jansen, 4. Time, 17:7. Had a slight accident not happened to Jansen, he would in all probability have made a better showing. The boys expect to run another race in the near future, and as the handicaps are to be changed to agree with this record a very exciting race is anticipated.

NEW CITY ELECTRICIAN.—Mayor Harrison has appointed Mr. Edward B. Ellicott to the office of City Electrician in place of Prof. J. P. Barrett. The new incumbent of the office is quite a young man, being but a little over thirty-one years of age. He was born in Batavia, N. Y., and after an extensive electrical experience joined the Western Electric Company, at Chicago, in 1890. Mr. Ellicott occupied the position of superintendent of construction with this concern at the time of his appointment. His experience, extending over a period of nearly a dozen years, has been of a character to particularly fit him for the new position. Mr. Ellicott was prominently connected with the electrical displays at the World's Fair and Atlanta Exposition, and is also the inventor of various appliances of no mean merit. He is a member of various Chicago clubs, and is liked by both politicians and others in his adopted city.

CROCKER-WHEELER ELECTRIC COMPANY'S CHICAGO HEADQUARTERS.—The important announcement has just been made that Mr. C. H. Wilmerding, the well-known consulting engineer, will hereafter direct the affairs, as Western manager, of the Crocker-Wheeler Electric Company, of New York. Mr. Wilmerding's headquarters have been established at Rooms 1514-1516, Old Colony Building. Mr. Julian Roe has been detailed as salesman, and a tried and competent construction force is employed in the office. In consequence of this new arrangement, the company's customers will have the advantage of dealing with the company and of obtaining direct the benefit of its well-known guarantees and its engineering ability. They will also have the convenience of direct telegraphic communication from Chicago to the factory at Ampere, N. J. The Crocker-Wheeler Company's affairs were formerly looked after in this territory by Messrs. Frederick Sargent and A. D. Lundy.

NORTHWESTERN ELECTRICAL ASSOCIATION.—The fifth semi-annual convention of the Northwestern Electrical Association will be held at La Crosse, Wis., commencing on Wednesday, July 21, next. Suitable arrangements have been made for quarters at the different hotels in La Crosse, and direct and alternating current, with abundant space, will be available and at the service of intending exhibitors. The Western Passenger Association has granted a rate of a fare and one-third, and special sleepers will leave Chicago at 10:15 P. M., July 20, via the Chicago & Northwestern Railway, for La Crosse. Mr. George Cutter, of Chicago, has charge of the transportation from and through Chicago, and Mr. Thomas R. Mercein, secretary of the association, whose headquarters are at Milwaukee, will look after transportation matters from and through that city. The papers to be read at the meeting are as follows: "Meter Tests," "220-Volt Lamps," "Use of Oil in Transformers," "Utilization of Exhaust Steam," "Evolution of Incandescent Arc Lamps," "Rotary Transformers," and "Fuels for Central Stations," the authors of the same being Prof. D. C. Jackson, Prof. George D. Shepardson, Prof. R. B. Owens, Mr. George L. Thayer, Mr. O. M. Rau, Mr. C. F. Scott and Mr. John C. McMynn. An enjoyable programme has been arranged by the Entertainment Committee, and will include a river excursion, picnic, lunch, trolley parties, etc.

St. Louis Notes.

ST. LOUIS, MO., June 28, 1897.

WANT A MONOPOLY OF THE EAST ST. LOUIS STREETS.—The East St. Louis Electric road has agents busy securing signatures from property owners, requesting the City Council to give it a monopoly to run its cars under long-time franchises on all the principal streets of East St. Louis.

SHE LOST HER TENANTS AND SUIT.—A Mrs. Chamberlain owns three houses just across the alley from the Missouri Electric Light & Power Company, and brought suit against the company for $15,000, asserting that her tenants were driven away by the noises caused by the power house machinery at night, and also that the walls of the houses were caused to vibrate and shake. A special jury sat on the case. The corporation won, but an appeal will be taken.

PROPOSED RAILWAY EXTENSION.—It is rumored that the Lindell and Missouri Street Railway systems, now under control of one management, are about to extend their trackage and increase the capital stock to $7,500,000. The new company will probably be called the Lindell Traction Company.

SALE OF STREET RAILWAY POSTPONED.—It looks now as if the Fourth and Arsenal Street Railway will not be sold Tuesday, as previously ordered by the court. The reason is that both parties to the suit have asked that the sale be postponed until that of the Peoples' Railway. The sale of the latter, which was also set for to-morrow, has been stopped by a writ of supersedeas. When the sale does take place it is said that the friends of Mr. Green will step in and protect him.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., June 18, 1897.

MR. E. T. PARDEE, who has represented the Fort Wayne Electric Corporation in Omaha, Neb., is in the city, and will probably locate here.

MR. C. C. CHESNEY, chief electrician of the Stanley Electric & Manufacturing Company, is in the city. He is visiting this coast in the interests of his company.

CHANGES OF LOCATION.—Mr. W. Stuart-Smith, consulting engineer, has moved to Room 26, Sheldon Building, San Francisco. The Pacific Coast District agency of the Stanley Electric & Manufacturing Company, John Martin, manager, has been moved to No. 300 California Street, San Francisco.

THE SAN GABRIEL ELECTRIC COMPANY, of Los Angeles, Cal., has been incorporated for the purposes of acquiring and selling power for application to mechanical and other devices. Directors: Robert M. Weed, Carroll Allen, Joseph D. Wiley, John A. Elliott and Sam J. Chase. Capital stock, $500,000, of which $25,000 has been subscribed.

LONG-DISTANCE TRANSMISSION.—The Kern River & Los Angeles Electric Power Company recently sent a surveying party out to work in the district where its extensive water supply originates. J. W. Eddy, of Los Angeles, Cal., is interested in the system, for which the pole line was surveyed some time ago. The distance of transmission would be 108 miles.

WATER POWER.—The recently-incorporated Cosmos Land & Water Company, which will operate in Shasta, Tehama and Trinity Counties, California, is expected to commence work in July. It is the intention to take water from the junction of the McCloud and Pitt Rivers. An electric railroad from Redding into Trinity County will be operated by electricity generated by the use of the above water power. San Francisco and Los Angeles capital is invested.

LARGE ORDER FOR GENERATING APPARATUS.—The Mutual Electric Light Company, San Francisco, recently ordered the following generating apparatus of the Fort Wayne Electric Corporation, through the San Francisco agency: Two additional arc machines, each having a capacity of 150 series lights; one additional 2000-volt alternator of 300-kw capacity; a 220-volt direct-current 300-kw generator, which will supply power to the new mains that are being laid. Two 600-hp tandem-compound Thompson-Corliss engines are being built at the Golden State Iron Works for this company. With the increased installation there will be a total capacity of 800 arc lights and 16,000 incandescents of 16 candle-power.

General News.

NEW INCORPORATIONS.

THE WESTERN ELECTRIC TELEPHONE COMPANY, Albert Lea, Minn., has been organized with a capital stock of $50,000.

THE PLYMOUTH TELEPHONE EXCHANGE, Plymouth, Wis., has been organized and the following officers elected: President, G. C. Hason; secretary, Frank Derrwaldt.

THE FULTON COUNTY TELEPHONE COMPANY, Lewiston, Ill., has been incorporated with a capital stock of $70,000, by John Skinner, J. M. Todd, J. H. Windhurst and Hart F. Farwell.

THE CASCADE POWER & LIGHT COMPANY has been organized and has filed articles of incorporation at Victoria, B. C. The promoters are Thomas J. Jones, Duncan E. Campbell, and George H. Haynes.

THE SADDLE RIVER TRACTION COMPANY, Passaic, N. J., has been incorporated with a capital stock of $100,000. The incorporators are Gen. B. W. Spencer, Michael F. Burns and Gilbert D. Bogart.

THE VALLEJO ELECTRIC LIGHT & POWER COMPANY. Vallejo, Cal., has been organized with a capital stock of $100,000. The directors are K. Casper, Vallejo; Julius Newman, Leopold Breuner and Isador Rosenberg.

THE PEND D'OREILLE POWER & LIGHT COMPANY has been incorporated at Victoria, B. C., with a capital stock of $1,000,000. The incorporators are John A. Finch, George Turner, Patrick Clark, Frank C. Loring and W. S. Norman.

THE EAST SIDE ELECTRIC LIGHT COMPANY, Bellevernon, Pa., has been formed with a capital stock of $1000. The incorporators are James N. Schoonmaker, George O. Morgan, James H. Reed, Winfred B. Carson and George B. Motherall, Pittsburg.

THE EAST KOOTENAY POWER & LIGHT COMPANY has filed articles of incorporation at Victoria, B. C., for the purpose of furnishing power and light to the cities of Roosland and Trail. The incorporators are Oliver Durant, Patrick A. Largey and Charles R. Hosmer.

THE DELAWARE VALLEY, HUDSON & LEHIGH RAILROAD COMPANY has been issued a charter by the State Department at Harrisburg, Pa. The directors are Miles G. Shoemaker, Rush M. F. Coolbaugh and Charles A. Woolsey. Capital stock, $825,000.

THE EASTMAN ELECTRIC LIGHT & TELEPHONE COMPANY, Eastman, Ga., has been formed and a charter obtained. The officers are as follows: W. N. Leitch, president and general manager; Walter M. Clements, vice-president, and John B. Caldwell, secretary and treasurer.

THE KOOTENAY POWER & LIGHT COMPANY, Victoria, B. C., has been formed for the purpose of supplying power and light by means of compressed air and electricity. Those interested are Herbert S. Holt, Frank Paul and William Doull, of Montreal, and Charles L. Ross, of Rosshire, Scotland.

THE WASHINGTON TELEPHONE COMPANY has been organized at Newcastle, Me., with a capital stock of $8000, for the purpose of operating a telephone line from Damariscotta to Waldoboro and Wiscasset. The officers are: President, P. H. Gay, of Damariscotta; treasurer, E. W. Nash, of Newcastle.

THE KINZUA & TIONA RAILROAD COMPANY has just been granted a charter by the State Department at Harrisburg, Pa., for the operation of a road to run from Tiona, Warren County, to Kinzua, McKean County. The directors are J. W. Campbell, A. P. Huey and H. I. Jamison. Capital stock, $80,000.

THE BRIDGEWATER & MIDDLEBORO STREET RAILWAY COMPANY, Bridgewater, Mass., has been incorporated for the purpose of constructing an electric railway from Bridgewater to Middleboro. The Board of Directors includes H. Fisher Eldredge, John M. Stetson, Cornelius Leonard, N. F. Ryder, Austin L. Baker, T. W. Crocker.

THE OPALESCENT ILLUMINATED SIGN COMPANY, New York City, N. Y., has been incorporated with a capital stock of $10,000. The directors are John J. Pulleyn, Lambert A. J. Muller-Thym, Edward J. McGuire and Michael J. Drummond, of New York City, and Frank Tuchfarber, of Cincinnati, Ohio.

THE UNION ELECTRIC HEATING & MANUFACTURING COMPANY, Portland, Me., has been organized for the purpose of manufacturing and doing a general business in electrical appliances of all kinds, with a capital stock of $200,000. The officers are: President, George H. Clark, of Boston, Mass; treasurer, Henry L. Eastman, of Hampstead, Vt.

THE EASTON, PALMER & BETHLEHEM STREET RAILWAY COMPANY, Easton, Pa., has been incorporated with a capital stock of $250,000. W. B. Ferguson, of Boston, is president, and Charles E. Barnes, of Plymouth, Mass., treasurer. Among the directors C. A. Richardson, of Boston. The incorporators are Frank E. Lowe, Michael P. McGrath, George A. Murch, and Wesley A. Kendall, Worcester, Mass., and N. Sumner Merrick, of Boston.

THE UNDERGROUND ELECTRIC WIRE COMPANY, Syracuse, N. Y., has been incorporated with the Secretary of State at Albany with a capital stock of $400,000. Those interested are William B. Kirk, Charles Hughes, Eugene Hughes and Peter J. Mack, of Syracuse; Anson M. Bangs, of New York City; John F. Gaynor, of Fayetteville, N. Y., and Benjamin D. Green, of Stamford, Conn.

THE DE KALB AVENUE & NORTH BEACH RAILROAD COMPANY, Newtown, Queens County, Brooklyn, N. Y., has been incorporated with a capital stock of $200,000. The incorporators are Henry B. Hyde, of Bay Shore; Louis Fitzgerald, Alfred Wagstaff and Duncan B. Cannon, of New York City; John N. Partridge, John E. Hains, Thomas Clark, J. V. Thomas, Ennis Benton and George W. Benton, of Brooklyn.

THE TELEGRAPH AND TELEPHONE.

SUMMITVILLE, OHIO.—A telephone line is being constructed between this place and Del Norte.

SANDUSKY, OHIO.—It is proposed to relay the telephone cable connecting Leamington with Pelee Island, in Lake Erie.

WHEATON, ILL.—Mr. H. M. Fisk, of Austin, Ill., has been granted a franchise to build a telephone exchange at this place.

SIOUX CITY, IA.—The Sioux City Telephone Company will extend its line throughout Northeast Nebraska, and take in several towns.

BLOOMINGTON, ILL.—The American Toll Company, of this city, will at once begin the construction of a telephone line from Bloomington to Cropsey.

LIMA, OHIO.—A new telephone line is projected to run between this city and Kenton, including the towns of Ada, Foraker, McGuffy, Harrod and Westminster.

NORTH PLATTE, NEB.—The telephone line recently built by a local company is now in working order, and is charging a rate of $2 per month for instruments.

GRASS LAKE, ILL.—A telephone line is being built to connect McHenry and intermediate points. This will give a through connection between Chicago and Antioch.

CANNON FALLS, MINN.—A telephone company has been organized here to build a telephone line between this place and Wastedo, with the expectation of running it later on to Hader.

DETROIT, MICH.—The directors of the Detroit Telephone Company have decided to establish a sub-station, with a capacity of 1000 telephones, on Woodward Avenue, near the railroad crossing.

CLEVELAND, OHIO.—The Home Telephone Company has received permission to lay about 5 miles of conduits through the business streets of this city. The work will be commenced at once.

CHICAGO, ILL.—The Western Electric Company, it is stated, has begun suit at Mobile, Ala., against the Home Telephone Company, of Mobile, for alleged infringement of switchboard patents.

JACKSON, MICH.—The annual meeting of the Citizens' Telephone Company was held a few days ago, and a Board of Directors elected. The annual report of the president, Hon. E. B. Fisher, shows that the present earnings of the company are at the rate of $50,000 a year, while the cost of operation is about $30,000.

TOLEDO, OHIO.—The annual meeting of the Harrison Telephone Company was held here a few days ago and the following Board of Directors was elected: H. S. Bunker, H. T. Cooke, Calvin Reed, George Hull, of Toledo, and C. A. Layton, M. D. Shaw and Jacob Hauss, of Wapakoneta. The company reports having 835 instruments in operation.

BRAZIL, IND.—The Central Union Telephone Company has been granted a franchise to construct and maintain an exchange in this city. The company purchased the local exchange here, and will extend and improve the same. The Central Union Company is constructing lines all over this and adjoining counties, connecting all towns of any importance.

DELPHI, IND.—The Carroll Telephone Company has completed its line between Delphi and Monticello, and the line is now open for business. It is probable that branch lines will be built to Sleeth and Yeoman, and other contemplated extensions will bring Delphi into telephonic communication with twenty-five or thirty towns in Northwestern Indiana.

MINNEAPOLIS, MINN.—The Telephone Committee of the City Council has voted against the 5 per cent. gross-earnings clause, so that 2 per cent. will be levied on 2500 telephones. Should the number exceed 2500, the excess is to be taxed 5 per cent. It is stated that these changes were made to accommodate the Mississippi Valley Telephone Company.

SPRINGFIELD, ILL.—Representatives of twenty-five independent telephone companies in Illinois met in this city on June 18, and perfected a State organization to be known as the Independent Telephone Companies Association of Illinois. The officers for the year were elected as follows: President, I. A. Simpkin, Mattoon; vice-president, Frank Brooks, Charleston; secretary, A. M. Howell, Hillsboro; treasurer, M. Weinberg, Augusta.

ELECTRIC LIGHT AND POWER.

DES MOINES, IA.—The city of Des Moines is in the market for a municipal lighting plant.

SABINA, OHIO.—The Town Council is advertising the sale of $50,000 in bonds for a combined electric light and water works.

MT. PLEASANT, IOWA.—At an election held a few days ago the proposition to take over the electric light plant was carried.

WHITE HILLS, ARIZ.—An electric light plant is to be established in this place and the apparatus has already been ordered.

COOPERSTOWN, N. Y.—The real estate and plant of the Cooperstown Gas & Electric Company will be sold at foreclosure sale.

LEXINGTON, KY.—It is stated that the trustees of the State College have decided to erect an electrical building at a cost of $20,000.

CENTREVILLE, MICH.—Messrs. H. J. Hampson & Co. have been granted a franchise for an electric light and power plant in this place.

VICTOR, COL.—The Victor Light, Water & Motor Company will begin the erection of a new power station east of the city, to cost $10,000.

HAMMONDSPORT, N. Y.—The proposition to establish a municipal electric light plant in that place has been voted down by a large majority.

CARBONDALE, ILL.—At a meeting of the City Council a franchise was granted to R. D. Bradbury to erect an electric lighting plant in Carbondale.

FLUSHING, L. I.—The Board of Trustees has called a special election for June 24 on the question of installing eighty-one additional street arc lights.

PALMYRA, N. Y.—The Palmyra Electric Light & Power Company has filed a certificate showing an increase of its capital stock from $10,000 to $30,000.

PITTSBURG, PA.—The Engineers' Society of Western Pennsylvania talks of erecting an immense electric plant to supply all Pittsburg with light and power.

LITTLETON, N. H.—Messrs. Kilburn and Remich contemplate establishing an electric light plant on the Richardson Mill property they recently purchased.

CINNAMINSON, N. J.—The Cinnaminson Electric Light & Power Company is preparing plans to erect a large building in which it will place its new plant.

ANN ARBOR, MICH.—The University of Michigan will install an electric light plant, using in payment for the same the $20,000 recently appropriated by the Legislature.

SHELBYVILLE, KY.—Mr. J. M. Johnson has secured the franchise for electric light and telephone in this place. Work on the telephone system will be commenced at once.

MAGNOLIA, MISS.—The franchise for the erection of electric lights and water works in the town of Magnolia was given to the Magnolia Gin & Light Company, of this place.

TOLEDO, OHIO.—The County Commissioners have practically decided to put an electric light plant in the court house to furnish light for the jail, armory and court house.

WOONSOCKET, R. I.—The City Council has renewed the contract for the street lighting in this city for a term of three years, on the basis of 40 cents per light per night.

TONAWANDA, N. Y.—The Board of Aldermen has awarded the electric lighting contract to the Tonawanda Lighting & Power Company for one year, at the rate of $90 per lamp.

HAMBURG, PA.—The Hamburg Electric Company has closed a contract to supply the borough with arc lights for a term of five years. The borough will pay $80 per light for an all-night service.

KEENE, N. H.—The Keene Gas Light Company will install a new electric light plant. The power will be generated at the company's station in Spragueville, where a large alternating-current dynamo will be installed.

NORTH WALES, W. VA.—The Borough Council has made a contract with E. K. Freed & Co., whereby the latter is to furnish 25-cp electric lights to the borough on the basis of $12 per annum per light. The contract runs for ten years.

PORTSMOUTH, N. H.—The new steam tower for the electric power plant of Messrs. J. & A. Walker is under construction and will be completed in the early summer, by which time it is expected that the plant will be in operation.

RUSHVILLE, ILL.—The Rushville Electric Light Company will make some improvements in its station by the addition of a large alternator and Corliss engine. Mr. H. E. Smith is superintendent and electrician of the company.

BROOKHAVEN, MISS.—The Mayor and Board of Aldermen will, on July 6, issue bonds to an amount not exceeding $40,000, for the purpose of raising money for the erection and ownership of an electric light plant, water works system, etc.

MANCHESTER, N. H.—The stockholders of the Manchester Electric Light Company have voted to authorize the issue of 5 per cent. bonds to an amount not exceeding $250,000 to retire $80,000 6 per cent. bonds, and pay for extensive improvements.

LYONS, N. Y.—It is stated that the Holland Trust Company, of New York City has begun foreclosure proceedings against the Newark Electric Light & Power Company, of Newark, N. Y., upon bonds of $50,000, held by the Trust Company.

TERRE HAUTE, IND.—A receiver has been appointed for the Terre Haute Electric Light & Power Company. The company was incorporated in 1885, with a capital stock of $30,000. The indebtedness of the company is stated to be $55,000.

LARUE, OHIO.—The Council has granted a franchise to Joseph Slanser and others to erect and operate within this village an electric light plant. A stock company will be incorporated at once, and the work of erecting the plant will be begun immediately.

PATERSON, N. J.—The Edison Electric Light Company will extend its plant in order to meet the increasing demand for electric light in this city. A 650-hp compound engine and generators of equivalent capacity will be installed at a cost of $30,000.

MONROE, MICH.—The Monroe Electric Light & Power Company and the Monroe Gas Light Company have been consolidated, thus terminating the fight which has existed between the city and the lighting company. The new company will have full control of the city's lighting.

FLUSHING, L. I.—Hereafter this village will be supplied with gas and electric light by the Flushing Gas & Electric Light Company, which has purchased the plant and franchises of the old gas company for $200,000. The capital stock of the new company is fixed at $300,000.

MADISON, WIS.—Sealed proposals will be received by the State Board of Control, until July 2, for an electric lighting and power plant for the Northern Hospital for the Insane, all in accordance with plans and specifications on file in the office of the State Board of Control, Madison, Wis.

BALTIMORE, MD.—Judge Stockbridge has signed an order authorizing the receivers to sell the property of the United States Power & Light Company, after giving three weeks' notice by advertisement. The money will be distributed to the creditors, after the costs have been deducted.

STONEHAM, MASS.—The town is at present without electric light, owing to a difference between the Selectmen and the Woburn Electric Light Company. The company has been notified to discontinue its service, the Selectmen claiming that the company has not lived up to its contract.

BANGOR, ME.—At a stockholder's meeting of the Skowhegan Electric Light Company, the directors were instructed to purchase the L. W. Weston & Co. mill property and water power for the sum of $40,000, to develop and build a power house, and to equip the same for carrying on an electric light business.

PULASKI, VA.—The Pulaski Town Council has granted a franchise to the Pulaski Electric Company, giving it exclusive control for twenty-five years. Seventeen arc lights of 2000-cp each will be supplied, five to be furnished free and twelve to be furnished at a cost of $72 each per annum, for ten years or more.

GLOUCESTER, MASS.—The Gloucester Electric Company has asked the Board of Aldermen that a location be granted to set poles for the support of wires in the several streets and avenues annexed, for the purposes of street lighting, as provided for in the contract with the city of Gloucester for electric light service.

BROOKLYN, N. Y.—A writ of mandamus has been granted in the Supreme Court, compelling City Water Works Commissioner Willis to issue permits to the Amsterdam Electric Light, Heat & Power Company to lay conduits in the streets of Brooklyn. The Amsterdam Company is the assignee of the State Electric Light & Power Company, which obtained a franchise in 1895.

JENKINTOWN, PA.—The Hatboro Council has granted a twenty-year franchise to local capitalists to erect and operate a water and light plant within the limits of the borough. It is proposed to absorb the Hollowell electric light plant, which ceased operations some months ago, and to increase the plant so as to extend it throughout the borough and adjacent territory. The improvements will cost about $25,000.

THE ELECTRIC RAILWAY.

AKRON, OHIO.—The Akron & Cuyahoga Falls Transit Company will extend its lines in Akron.

OLEAN, N. Y.—It is stated that the street railway will be extended to Portville, a distance of 6 miles.

COTTAGE CITY, MASS.—An electric railway is proposed between Vineyardhaven and Edgartown. It will carry freight as well as passengers.

OLEAN, N. Y.—Work has been commenced upon the Olean & Portville trolley line. The road will be about seven miles long and will be in operation by fall.

BEVERLY, MASS.—The Board of Aldermen has granted permission to the Lynn & Boston Railway Company to equip its Beverly Cove branch with electricity.

SPRINGFIELD, ILL.—A bill has passed both Houses of the Legislature authorizing five-cent fares and fifty-year extension of all street railway franchises in Illinois.

LEICESTER, MASS.—There is considerable talk concerning the construction of an electric road between Rochdale and Leicester, but no decided action has been taken.

NEW KENSINGTON, PA.—A syndicate headed by Col. Wayman, of New Kensington, proposes to erect a line of railway through Murraysville and Delmont to Greensburg.

MILWAUKEE, WIS.—The Milwaukee & Racine Electric Railway was formally opened for business on June 16. The running time between the two cities is one hour and fifty minutes.

WEST NEWTON, PA.—The McKeesport & West Newton Street Railway Company has accepted the right of way granted by West Newton, Pa., and will begin work shortly on the new line.

NEWARK, N. J.—The Clinton Township trolley line of the Consolidated Traction Company will be extended from its present terminus at Clinton Avenue and Fabyan Place to Elizabeth Street.

WAYNE, ME.—At a special town meeting held at Wayne it was voted to aid the Franklin, Somerset & Kennebec Railroad to the extent of $2,500, provided the tracks were laid through the town.

PITTSBURG, PA.—The Allegheny Select Council has garnted a trolley franchise to the Lacock Street Railway Company, the Ohio Valley Electric Company and the Pittsburg Union Passenger Railway Company.

NEW BRITAIN, CONN.—The Consolidated road has reduced the fare for local traffic between New Britain and Berlin from 10 cents to 5 cents. The fare is now the same as that charged by the old trolley line.

MILWAUKEE, WIS.—Henry C. Payne announces that he has concluded negotiations with Cleveland capitalists for the formation of a company to build an interurban electric railway in the Fox River Valley.

EMPIRE, KAN.—A franchise has been granted by the Town Council of this place to the Southeast Kansas Electric Railway Company, and it is expected that work on the construction of the line will be commenced very shortly.

ROCKFORD, ILL.—An electric road from Marseilles to Lake Geneva now seems to be assured, the promoters of the line having ample capital subscribed to carry the project through. The road will pass through several towns.

MEADVILLE, PA.—Messrs. Johnson & Wickersham, of Media, Pa., received the contract for building an electric railway in this city. The line will be constructed to a place known as Ponce de Leon Springs, 6 miles from here.

ELWOOD, IND.—The Indianapolis, Anderson & Marion Electric Railway is said to be assured. The contractor for the line has bound himself to complete the thirty-one miles of road between Marion and Anderson within 100 days.

PORT HURON, MICH.—The City Electric Railway Company has been granted a new charter for thirty years. The company has agreed, in consideration for this extension, to run its cars from the tunnel station to Gratiot Beach for one fare.

PLAINFIELD, N. J.—It is stated that the projectors of the electric railway between Elizabeth and Plainfield have secured a large number of consents from property owners in Westfield, and that an application for right of way through the town will soon be made.

MT. CLEMENS, MICH.—Franchises have been granted by the Township Boards of Erin and Harrison for an electric railway along the lake shore. The franchise is granted to the Ranney-Fordyce syndicate, and this is the third one given by the Erin Township.

CHARLESTON, S. C.—The new electric railway company ran its first trolley car in this city on June 24. This is the first electric railway line laid down in Charleston, and the opening of the road was the occasion of considerable rejoicing on the part of the citizens.

ALLEGAN, MICH.—Mr. Charles E. Temple, of Grand Rapids, Mich., is interested with some Eastern men in building an electric railway in this place. The line will extend to Fennville, a distance of six miles. Application for a franchise in Allegan is now before the Council.

ROCKVILLE, CONN.—The City Council has eliminated the time limit from the permit granted to the Hartford, Manchester & Rockville Tramway Company for the construction of its line to Market Street. The company will be required to go to East Street in one year.

HAMILTON, OHIO.—The Cincinnati & Hamilton Electric Street Railway Company has secured a fifty-year franchise from the County Commissioners over the Cincinnati & Hamilton pike to the north line of Hamilton County. This makes a continuous electric line from Dayton to Hamilton County.

DANVILLE, PA.—Messrs. J. M. Fitzgerald and Elias Nesbaum, representatives of the North Susquehanna Street Railway Company, are in the city endeavoring to secure the right of way for their line between this place and Bloomsburg. The right of way was secured through Danville some time ago.

MEADVILLE, PA.—The Meadville Electric Company has awarded the contract for the construction of its power house to Messrs. Isaac Walker & Son, Philadelphia. The power house will be built of brick, steel and iron, and will cost, including engines, boilers, electrical apparatus, piping, etc., about $80,000.

FRANKFORT, KY.—The Frankfort & Suburban Electric Street Railway Company has been organized in this city, and the following named officers elected: Charles R. Crain, Springfield, Ohio, president; Pat McDonald, Frankfort, vice-president; John T. Buckley, Frankfort, secretary, treasurer and general manager.

BOSTON, MASS.—The Milford, Holliston & Framingham Railway Company has petitioned the Railroad Commissioners for approval of its purchase of the Milford & Hopedale Street Railway for $60,000. The purchasing company wishes to issue additional stock for the necessary $60,000, and bonds to the amount of $160,000 for improvements in the property.

JERSEY CITY, N. J.—At a special meeting of the Consolidated Traction Company's directors, the purchase of the trolley line from Jorolemon street in Belleville, to Passaic City, was approved. The line was formerly owned by the Passaic & Newark Traction Company, and this acquisition gives the Consolidated Company a continuous line from Jersey City to Paterson.

CROWN POINT, IND.—A franchise has been granted to the local syndicate for the construction of electric railways in this section of the county, touching Hammond, Crown Point and other places. The line is to be built within two years, and those interested are George J. Strable, Malcolm T. Hart, D. Wolf, John Brown and Robert P. Bale.

YOUNGSTOWN, OHIO.—A freight, baggage and package car has been placed on the Mahoning Valley Electric Railway, which runs from this city to Warren. Arrangements have been made with the Trumbull Electric Railway Company to run the car over its line between Niles and Warren. The car will carry express packages for the American Express Company between Youngstown and Warren.

PHILADELPHIA, PA.—The new bridge of the Fairmount Park Trolley Company over the Schuylkill River at Strawberry Mansion was opened to traffic a few days ago. Between 10,000 and 15,000 people were on hand to greet the first car that crossed the bridge. It was gayly decorated with flags and bunting, and among its passengers were the president, chief engineer and other officials of the road. It is estimated that 20,000 people took a trip over the road on the opening day.

AKRON, OHIO.—Mayor Young is at work on a plan, which, he thinks, will bring to time the street railway companies which have neglected to heed the ordinance requiring payment of an annual license fee of $2 for every car operated within the city limits. He proposes to amend the present ordinance, so that upon the payment of the regular fee, companies will be compelled to place a card in each car, showing that it has been licensed according to law. He would also make it a misdemeanor, punishable by a fine, for any street railroad official to operate in Akron a car not containing a regular license card. An ordinance of this kind will be presented to the Council soon.

PENSACOLA, FLA.—It is stated that a complete system of electric street railways is to be built in this city and that the line to the Navy Yard and forts will be changed to electric power. Mr. W. H. Bosley, of Baltimore, recently purchased the property of the Pensacola Terminal Company, and it is reported that he has obtained a franchise from the City Council for extending the lines of street railways and converting the entire system from horse-power to electricity. Work upon a large electric light plant will soon commence and the promoters expect to have electric cars running all over the city and to the Navy Yard and forts before winter.

SUFFIELD, CONN.—The Selectmen of this town have accepted the plan of route for the Springfield & Southwestern Street Railway Company. According to the charter, the road must be in full operation between the Massachusetts State line and West Suffield, a distance of 10 miles, on or before June 1, 1898. It is the plan of the company to eventually connect with the Hartford Street Railway, also to build its line to Springfield, Mass. The temporary organization of the company was recently effected, the officers elected being: H. K. Ford, president; E. P. Bartholomew, secretary; A. Lyon, treasurer. It is stated that the company will be reorganized, with New York and Philadelphia capital in control.

LEGAL NOTES.

ALLEGED INFRINGEMENT OF PAPER CABLE PATENTS.—The National Conduit & Cable Company, of New York City, has begun an action against the New York & New Jersey Telephone Company, which will be tried in the United States Circuit Court in Brooklyn next August. The plaintiff alleges that the defendant has infringed on its patents, covering the manufacture of paper insulated cable. The National Conduit & Cable Company, over a year ago, bought out the Norwich Insulated Wire Company, and secured thereby the title to certain letters patent of the United States, giving to it the sole right for the use of insulated wire with spirally wound and lapping strips of paper composed of pure vegetable fibre. This paper is applied with a waterproof adhesive substance, consisting of a thin solution of india rubber. This form of cable is very extensively used in cable work, and it is stated that there is at the present time about $15,000,000 worth of this kind of cable now in use in this country. It is alleged that the Bell Telephone Company, which has adopted the paper-covered cable in nearly every city where its instruments are used, has itself made the patented cable. This, it is claimed by the National Company, is an infringement of the latter's patents.

THE BUCKEYE ELECTRIC COMPANY.—Proceedings in quo warranto have been commenced in the Circuit Court at Cleveland, Ohio, to declare forfeited the rights and franchises of the Buckeye Electric Company to do business in Cleveland. The contract between the Jandus Electric Company, of Cleveland, and the Manhattan General Construction Company, of New York, which, it is alleged, was recently abrogated, is the basis for this suit. It is claimed that the Buckeye Company was responsible for this broken contract by committing acts exceeding its corporate scope in Ohio. The allegation against the Buckeye Company is that it purchased stock from the Jandus Company and carried it on the books as part of its assets, and it is claimed that the Buckeye Company by virtue of this ownership assumed control of the Jandus Company, and terminated the contract with the Manhattan Com-

pany, by the terms of which the latter was to sell goods made for and owned by the Jandus Company. It is stated that the Buckeye Electric Company will take no legal steps in the case brought against it by the Manhattan General Construction Company until its officials fully understand the allegation made against the company in the petition filed in the United States Circuit Court. The officials state that they do not understand fully the import and details of the allegations, and that the filing of the suit was a complete surprise to them.

PERSONAL NOTES.

MR. J. P. WILLIAMS, whose features are presented herewith, was born on January 20, 1863, in Brooklyn, N. Y. He was graduated from the College of the City of New York, and his first appearance in the electrical field was with Mr. Thomas A. Edison, in the early days of the phonograph. He was general traveling agent for the North American Phonograph Company, and after the collapse of that enterprise, went with the Schaffer Telephone Company. He remained with this concern about two years, and then became identified with the Electric Forging Company, of Boston, Mass., for whom he sold the rights for the Burton process for the Dominion of Canada and Illinois. Mr. Williams installed and operated the large working exhibit of the Electric Forging Company at the World's Fair in Chicago, and after the failure of that company he turned his attention to motor work. He invented and brought to commercial success the Globe motor. He afterward gave two years' attention to experimental work with the Globe motor, with the result of the production of the Paragon motor which is now well known to the trade.

MR. J. P. WILLIAMS.

MR. MAURICE W. HUNTER, of Thomas & Hunter, electrical contractors, Charleston, S. C., called recently at the office of THE ELECTRICAL WORLD. Mr. Thomas has been engaged for some time in building the independent telephone exchanges at Augusta, Ga., and Charleston, S. C. These two exchanges comprise between them over 1200 stations. He is now engaged in the construction of exchanges at Spartansburg, S. C., and Savannah, Ga., the latter being a very large and finely equipped exchange. Mr. Thomas reports great activity in independent telephone matters in the Southern States, and much extension of toll lines through the Carolinas and Georgia.

PROF. R. B. OWENS, who has been placed in charge of the Electrical Section, Department of Exhibits, of the Trans-Mississippi Exposition, which will be held in Omaha, Neb., from June 1 to November 1, 1898, is a native of Maryland. He obtained his education in his native State, studying at Johns Hopkins University, in Baltimore, where he stood well in mathematics and physics. In 1891 he obtained the post-graduate degree of Electrical Engineer from Columbia University, and was a member of the first class in the United States to receive this degree. During the intervals of his school preparation he acquired a large practical experience, first with the old Baxter Motor Company, then with the Excelsior Company, and also as superintendent of the Thomson-Houston station at Greenwich, Conn. Shortly after receiving his degree Professor Owens was appointed adjunct professor of electrical engineering in the University of Nebraska, and in 1894 he was made full professor, having in the meantime served as one of the chiefs of the electrical exhibits at the World's Fair. Full charge of the department of electrical and steam engineering of the University of Nebraska was conferred upon Professor Owens in 1895. He believes that the technical school should be in close touch with the best practice, and usually spends his summers in work that increases his experience in solving actual everyday problems. It is safe to state that the electrical department of the Trans-Mississippi Exposition will be greatly benefited by his reputation, knowledge and experience. His appointment as commissioner is received with much favor on account of his personal, business and technical qualifications. He will have full charge of the work of organizing and superintending the electrical department. It is the intention of the exposition managers to make the occasion one of great interest in the scientific and practical study of electricity.

PROF. R. B. OWENS.

Trade and Industrial Notes.

DIRECT-CURRENT TRANSFORMERS.—A very completely illustrated bulletin of motor-dynamos and dynamotors has just been issued by the Crocker-Wheeler Electric Company, New York. Plants in which these apparatus have been installed are illustrated, and a general description of the machines and dimensional diagrams and data are given.

POPULAR ENGINES.—One by one, it is stated, the leading dry goods houses of New York City are adopting the Ball & Wood engines as their standard for use in their light and power plants, the latest instance being that of Messrs. B. Altman & Co. Over a year ago this firm installed several engines of another make, but its latest addition has been a 225-hp direct-connected Ball & Wood engine.

EXPERIMENTAL ELECTRICAL SUPPLIES.—The Boston Motor Company, Boston, Mass., in a catalogue just issued, gives information and prices of its various products. These include the Boston motor and battery outfits of all sizes, dental motor outfits, direct-current fan motors for 110 volts, batteries of all types, X-ray apparatus, etc. The company makes a specialty of experimental apparatus.

THE TRUMBULL COUNTY COURT HOUSE.—The Warren Electric & Specialty Company, Warren, Ohio, manufacturer of "high-grade, anti-trust" incandescent lamps, is distributing to the trade a little pamphlet, giving an account of its success in obtaining the contract for the lamps to be used in the court house of Trumbull County, Ohio. The Warren Company wishes to impress the fact that it is not a member of the so-called Lamp Trust.

A MODEL ISOLATED PLANT.—The electric generating plant at the store of A. Alexander, corner of Sixth Avenue and Nineteenth Street, New York City, it is expected, will be a model of its type. The C & C Electric Company, New York, has been awarded the contract for a 60-kw direct-connected multipolar dynamo for this plant. The machine will be of the six-pole type. This particular make of dynamo, it is stated, was selected after careful consideration.

ELECTRICAL WOODENWARE.—The Point Marion Manufacturing Company, Pittsburg, Pa., is manufacturing a line of high-class oak and locust pins, brackets, mouldings, cross-arms, etc., that it would be well for those interested to investigate. The company has ample facilities for the production of these goods, and prides itself on its prompt shipments. The quality of the wood used in these different appliances is the best obtainable, and the greatest care is exercised in their manufacture.

PUMPS AND HYDRAULIC APPARATUS.—The fiftieth edition of the general catalogue of pumps and hydraulic apparatus manufactured by Rumsey & Co., Limited, Seneca Falls, N. Y., has just been issued. The catalogue is very completely illustrated and shows an almost endless line of manufactures produced by this concern. Besides describing and illustrating the various devices, the catalogue contains a great deal of engineering information which will be of value to all interested in hydraulics.

SUMMER SCHOOL OF EXPERIMENTAL ENGINEERING.—Cornell University has just issued an announcement of courses of instruction at the summer school, which will be held from July 5 to August 14. Among the courses is experimental engineering, which is conducted by Messrs. Preston and Eldredge. The laboratory work covers three hours a day, five days a week, and is conducted by Mr. Preston. Mr. Eldredge will deliver a course of lectures on practical steam engineering, including the testing of steam engines and boilers and of steam plants.

MR. F. M. HAWKINS, who was for a long time connected with the Electric Engineering & Supply Company, Syracuse, N. Y., and for the past three years New York representative for the same company, has taken the agency for Pass & Seymour's electrical china specialties and the Crouse & Hinds Electric Company's knife switches and switchboards. He has opened offices at 39-41 Cortlandt Street, New York City, where he will carry in stock a full line of the above-named firm's goods. He reports a good and improving business.

FAN MOTORS IN DEMAND.—Notwithstanding the unusually cold weather experienced all over the country during the month of May, the Electric Appliance Company, Chicago, reports that the few days of hot weather in June started the fan business going in good shape, and give promise of a prosperous season. The Electric Appliance Company states that it still has some copies of its fan motor catalogue left, which it will be glad to send to the trade upon application. It is a complete book of all styles of fan motors.

TRIUMPH APPARATUS.—The Triumph Electric Company, Cincinnati, Ohio, has just issued a new catalogue of its electrical apparatus. It contains several very excellent illustrations of the various types of apparatus produced by this company, besides many views of prominent installations of Triumph machines. The popularity of this company's apparatus is due chiefly to the careful attention given to every detail of manufacture. Rigid factory inspection and tests are given every machine before shipment. The company has a modern and well-equipped plant for the manufacture of its machines, excellent views of which are also included in the catalogue. The Triumph machines are adapted to any work whatever, and the company makes a feature of producing machines after special designs for special work.

CONDENSERS.—Jet, surface and self-cooling condensers form the subject of a special catalogue just issued by Henry R. Worthington, New York. The Worthington condensing apparatus have been attached to engines of almost every kind and size, to such an extent that at the present time they are maintaining a vacuum upon engines aggregating 1,000,000 horse-power, and with a saving of money varying with the cost of fuel in the different locations in which they are used. Different forms of these condensers and their applications are liberally illustrated throughout the catalogue, at the back of which are added several valuable engineering tables and other information of the same nature.

A MODERN POWER HOUSE.—The New York & Staten Island Electric Company is erecting, at Livingston, S. I., a new power house of modern construction. The walls of the building are brick, and the roofs have steel trusses covered with corrugated iron. The roofs are arranged with suitable monitors, with skylights for light and ventilation. On the building is a large wire tower of steel construction. The engine room is arranged for a traveling crane of 15 tons' capacity. The building has been constructed with the idea of having it absolutely fire-proof, and arranged in an up-to-date manner. The roof of the engine and dynamo portions of the building is lined underneath the corrugated iron with the Berlin Iron Bridge Company's anti-condensation fire-proof roof lining. The Berlin Company has the contract also for furnishing and erecting all the steel framework and covering for the plant.

PATRIOTISM FROM PROVIDENCE.—The story of "The Star Spangled Banner" is the subject of this year's patriotic manifestation, which expressions of youthful joy emanate with unfailing regularity, at the proper season each year, from the American Electrical Works, Providence, R. I. The souvenir consists of two cards tied together with a neat little bow of silk ribbon. On the front card is affixed a small silk American flag, besides the picture of the walls of a fort, from which cannon are blazing away in commemoration of the return of Independence Day. On the second card is printed the hymn "The Star Spangled Banner," headed with a bar of the glorious tune. The patriotic spirit of the American Electrical Works should be more extensively cultivated in the electrical field for the diversion from business cares that it affords.

Business Notices.

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Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 15, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

584,737. TELEPHONE; C. C. Gould, Philadelphia, Pa. App. filed Feb. 9, 1897. In a telephone-transmitting apparatus, a mouth-piece, a series of nipples secured in a wall thereof, a plurality of transmitters, and a connection leading from each nipple to each of said transmitters.

584,750. INCANDESCENT-ELECTRIC LAMP; C. E. Scribner, Chicago, Ill. App. filed April 24, 1893. In an incandescent-electric lamp, the combination with a bulb, of a metallic ring encircling the neck thereof, a metallic cap hermetically sealed to said ring, said cap provided with an annular space, a leading in wire soldered to said cap, an insulating plug passed through and sealed to said cap by a metallic ring, a leading-in wire sealed through said plug, and a carbon filament in circuit with said leading-in wires.

UNITED STATES PATENTS ISSUED JUNE 22, 1897.

11,613. INSULATED SUPPORT FOR CONTACT RAILS; A. Hanson and J. R. Chapman, Chicago, Ill. App. for re-issue filed October 31, 1896. In an insulated support for contact rails, the combination, with a metallic base or standard, of a metallic pin provided with screw threads at the lower end adapted to engage a tapped hole in said base or standard, and with a shoulder adapted to rest against the top of said standard, said pin being provided with a layer of hard insulating material, moulded thereon to render said pin insulating, said layer of insulating material being enlarged at the upper end to form a head, threads being formed upon said head, and a metallic rail support provided upon the under side with a socket for the reception of said threaded head, said socket being provided with screw threads to receive and engage the threads provided upon the enlarged head of the pin, said rail support being provided with a petticoat surrounding said socket.

584,798. BURGLAR ALARM; H. M. Sutton and W. L. Steele, Dallas, Tex. App. filed Oct. 29, 1895. The method of guarding or protecting electric alarm-circuits extending between a receiving station and a protected structure which consists in rapidly and continuously alternating the polarity of a current of constant strength and alternately shifting this current from one set of main-line wires to another set of line-wires, thereby leaving one set of main wires momentarily electrically dead at a given moment of time, while another set is momentarily charged with the current and causing an alarm signal to operate at the receiving station upon a variation of the current strength when induced solely by extraneous interference with the circuits.

584,810. TELEPHONE TRANSMITTER; R. S. Barnum, Chicago, Ill. App. filed July 9, 1896. The combination in a telephone transmitter of an electrode provided with one or more cavities therein for the reception of finely divided particles of conducting material and one or more tufts of elastic-fibrous material arranged within said cavities.

584,819. TELEPHONE ANNUNCIATOR, CALL BELL AND FIRE ALARM; M. Garl, Akron, Ohio. App. filed April 6, 1895. A device for a telephone for making a speaking-circuit from the main office, consisting of two posts forming a part of the electric circuit between the various rooms, a sliding bar mounted between said posts, upwardly projecting contacts on said bar, upwardly projecting contacts adapted to engage the contacts on the sliding bar, a bushing in a perforation behind said contacts, a plug adapted to be inserted in said bushing to make complete electric connection between the rooms.

584,823. COMBINED BRACKET AND INSULATOR; G. W. Mead, Shellsford, Tenn. App. filed Dec. 21, 1896. The combination, with a support, of a combined bracket and insulator screwed into the support, and a brace connected to the support and the bracket.

584,831. TROLLEY; W. J. Smith, Gloucester City, and W. G. Johnston, Woodbury, N. J. App. filed Aug. 5, 1896. In a trolley, a fork having a shank in which is formed a socket of rectangular or equivalent cross-section, a pole whose upper end conforms to the cross-section of the socket, a latch for securing the fork upon the pole, and a wheel journaled within said fork.

584,843. AUTOMATIC SWITCH FOR ELECTRIC CIRCUITS; R. Belfield, London, England. App. filed June 19, 1895. An automatic circuit-closing and opening switch comprising stationary and movable contacts, a local circuit having its own source of current, an electric motor therein rotatable in one direction only, switch-actuating mechanism intermediate the rotating member of the motor and the movable contacts, a main circuit and an electromagnetic device therein for opening and closing the motor circuit.

584,848. ELECTROMAGNET; C. P. Bostian, Milton, Pa. App. filed April 22, 1897. An electromagnet having one or more perforations through its core and a rod of magnetizable material within and nearly filling each perforation, said rod or rods being insulated from the core.

584,853. THERAPEUTIC ELECTRIC-CURRENT GENERATOR; E. W. Chellis, Erie, Pa. App. filed May 5, 1897. In a therapeutic magneto-generator, the combination with a casing, of a spring motor in one side of said casing, with means for rewinding said motor, and field-of-force magnets, and an armature located in the opposite side of said casing with connections between said armature and motor, with terminals for leading off the current from the said armature.

584,856. CONTROLLER FOR ELECTRIC MOTORS; H. P. Davis, Pittsburg, Pa. App. filed Oct. 28, 1896. The combination with an electric circuit and a resistance normally included therein, of a switch and an actuating magnet for gradually reducing the amount of said resistance in circuit, means for short-circuiting said magnet when the minimum resistance is secured, and a second magnet for maintaining said last-named condition until the circuit is interrupted.

584,867. ARC-LAMP CARBON; T. M. Foote, Chicago, Ill. App. filed Feb. 17, 1896. As a new article of manufacture, a carbon for electric arc-lamps having a longitudinal groove therein, including the centre or core of the carbon, so as to penetrate into the crater and apex formed at the end of said carbon.

584,868. TELEPHONE; J. T. Gent, A. W. Stavelet and I. H. Parsons, Leicester, England. App. filed Dec. 11, 1895. In a telephone, the combination with the diaphragm, of a variable resistance device consisting of suitable conducting material in a granulated or comminuted state, a movable containing or holding receptacle for said material, a movable telephone support and intermediate connections between said support and the containing or holding receptacle whereby the latter is moved when the telephone is removed from or replaced upon the support.

584,871. TELEPHONE BRACKET; A. Y. Gordon, Massillon, Ohio. App. filed Nov. 27, 1896. The combination of a hinged arm having attached to the free end thereof a short bar, a transmitter plate carrying said transmitter, a swiveled handle provided with compartments, and one of said compartments weighted, and a transmitter located above the weighted handle.

584,873. ELECTRIC RAILWAY; F. W. Hunter, Cranford, N. J. App. filed Nov. 17, 1896. In an electric railway, the combination of a slotted conduit, two parallel-insulated conductors of the same polarity suspended within the conduit on all sides, an electrically propelled car, a collector device extending from the car into the conduit, and a wide roller-contact journaled upon a transverse journal-bearing and resting upon the upper surface of both conductors, and a connection between the roller contact and collector device permitting of free vertical motion to the roller to follow the vertical irregularities of the conductors.

584,911. ELECTRIC RAILWAY SYSTEM; G. Westinghouse, Jr., Pittsburg, Pa. App. filed Nov. 26, 1892. In an electric railway system, the combination of a continuous trolley wire, a contact cylinder having a plurality of grooves and making uninterrupted engagement with said wire, a fixed vertical support for said contact cylinder, a car on which said support is mounted, and yielding supports for said trolley wire, each consisting of a centrally supported sustaining wire, and attachments between the ends of said sustaining wire and said trolley wire.

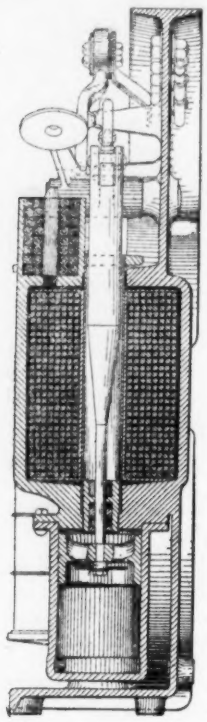
584,912. BRUSH-HOLDER FOR DYNAMOS; J. H. Yearsley, Philadelphia, Pa. App. filed April 8, 1897. In a brush-holder for dynamos, a box in which the brush is adapted to be fed toward the commutator, two arms pivoted at one end to the box and having their free ends resting upon the brush, a cross-piece or bridge uniting said arms, and a spring adapted to depress said bridge toward the box, whereby the arms are caused to press upon the brush with a constant and uniform pressure.

584,918. ELECTRIC RAILWAY TROLLEY; E. M. Bentley, New York, N. Y. App. filed June 4, 1896. The combination of a trolley arm fixed laterally with relation to the car and normally held at a constant elevation, a pivoted

end section thereon, a spring acting to move the end section with relation to said arm in an upward direction against the conductor, a fastening between the end section and trolley arm, holding the former against lateral movement relatively to the latter, and a contact-roller on the said end section having a length equal to the lateral deviation of the conductor in both directions from a central position.

584,936. ELECTRIC CONDUCTOR; I. W. Henry, New York, N. Y. App. filed Sept. 15, 1896. A submarine conductor, comprising a conducting core inclosed within a sheath of waterproof insulating material capable of preserving its insulating properties at great depths in water, an inclosing sheath of fibrous material, and an armor composed of non-magnetic wires side by side.

584,957. ELECTROTHERAPEUTICAL APPARATUS; F. J. Patten, New

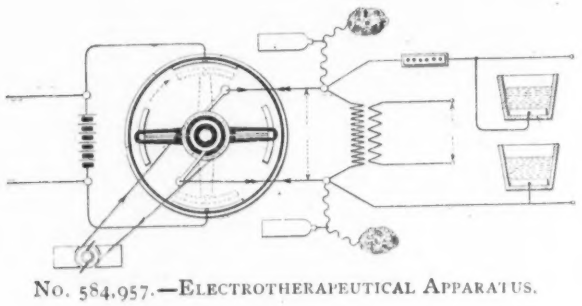


No. 584,856.—Controller for Electric Motors.

York, N. Y. App. filed Sept. 30, 1896. In electrotherapeutic apparatus, a source of electric energy; leads therefrom to the terminals of a source of a current-reversing apparatus adapted to transform said current to a uniformly and gradually alternating unbroken-current apparatus to devices for applying said transformed current to the human subject.

584,983. ELECTRIC ARC LAMP; A. Bureau, Brussels, Belgium. App. filed Jan. 27, 1897. In an arc lamp, the combination with the frame and the chain connecting and operating the carbons, of a grooved pulley supporting said chain, a fulcrumed frame carrying said grooved pulley, an iron core on each side of the fulcrumed frame, a wire coil on one of said cores, two differentially wound coils on the other core, an armature supported on one end of said fulcrumed frame and at right angles to said cores, and adapted to be controlled thereby, a brake wheel pivotally secured in the fulcrumed frame and parallel to the grooved pulley, gear connections between said brake wheel and the grooved pulley, and also carried by the fulcrumed frame, a brake fulcrumed in the frame and insulated therefrom and metallically connected with the differentially wound coils, and metallic connections between the wire coils and the brake wheel.

585,019. APPARATUS FOR ELECTRIC THERMAL TREATMENT OF METALS, ORES, ETC. G. D. Burton, Boston, Mass. App. filed Nov. 30,



No. 584,957.—Electrotherapeutical Apparatus.

1896. In an electrolytic-heating device, a main tank adapted to receive the electrolytic solution and provided with a well in combination with a second tank provided with a fluid conductor adapted to conduct the solution to the well, whereby the well may be kept constantly full to overflowing.

585,026. TIELESS INSULATOR; E. Delery, New Orleans, La. App. filed Jan. 11, 1897. An insulator comprising two sections, one of which is provided with a screw-threaded attaching bolt, and an annular flange of less diameter than said section, and having a vertical wire-receiving slot formed therein, and screw-threads formed upon both its inner and outer walls, and the other section having a screw-threaded socket adapted to fit over and engage the screw-threads of the annular flange, and a screw-threaded stud adapted to fit into said flange and engage the screw-threads upon the interior of the same.

585,030. MAGNETIC CIRCUIT-BREAKER; W. E. Harrington, Philadelphia, Pa. App. filed Dec. 26, 1895. In an automatic magnetic circuit-breaker, the combination with a switch and contacts of a solenoid-coil and core vertically movable therein, a switch-arm approximately parallel to the core when the switch is closed, and an independently movable means above the core for communicating the force of the impact of the movable core to the switch-arm to throw it out of contact.

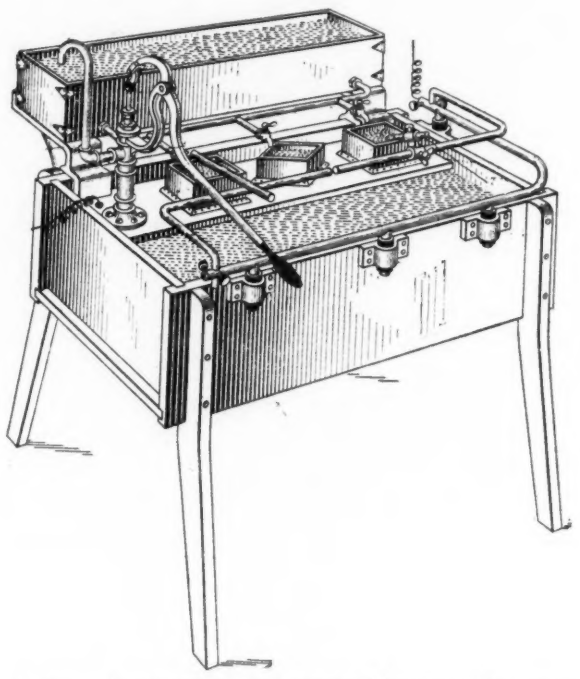
585,047. CONDUCTOR FOR UNDERGROUND ELECTRIC RAILWAYS; C. Petersen, San Francisco, Cal. App. filed Jan. 29, 1897. A subway for electric conductors, consisting of a tube or tunnel formed by angle plates, the upper edges of which approach each other to form a slot, and the lower edges have flanges adapted to secure them to the supporting structure, supplemental angle-plates fitting the adjacent edges of the main channel irons, and stay-bolts connecting the outer edges of the supplemental plates with the exterior bottom flanges of the main channel irons.

585,072. AUXILIARY FIRE-ALARM SYSTEM; R. E. Alexander, Yonkers, N. Y. App. filed Oct. 31, 1895. In an electric alarm system, the combination of a main-circuit signal-box, comprising a let-off magnet, a testing mechanism, and auxiliary boxes, a normally closed circuit containing the testing mechanism and auxiliary boxes in series, and a second closed-circuit controlled by the first, including the testing mechanism and the let-off magnet.

585,094. VALVE APPARATUS; F. Gray, Chicago, Ill. App. filed Jan. 4, 1897. In a valve apparatus, a plurality of valves, an intermediate chamber or chambers between the valves, which latter are held to their seats by pressure, a supplemental chamber containing a circuit making or breaking device, which chamber is connected with the intermediate chamber, whereby admitted pressure to the intermediate chamber operates the circuit maker or breaker.

585,137. MULTIPLE FILAMENT REGULATING INCANDESCENT LAMP; C. Truitt, Columbia, Mo. App. filed Feb. 15, 1897. The combination of a lamp, multiple filaments of varying candle-power inclosed within said lamp, a socket in which the lamp is fitted for rotation on its longitudinal axis, and a switch mechanism, the elements of which are constructed as parts of the lamp and the socket and have terminal plates, one of which is common to the filaments, and the others of which are connected individually to separate filaments, said switch mechanism arranged, by adjustment of the lamp, to bring the filaments in series or in parallel, or to direct the current through the filaments separately, or to cut the filaments out of the circuit.

585,138. ELECTRIC ALARM FOR DOOR LOCKS; P. V. Vandevelde, Corona, N. Y. App. filed April 6, 1897. An electrical alarm for doors, comprising a lock or latch casing, a longitudinally movable latch-bolt mounted therein, an insulated spring connected with said casing adjacent to the rear end of the latch-bolt, and adapted to be struck thereby, and an electric



No. 584,019.—Apparatus for Electric Thermal Treatment of Metals, Ores, etc.

alarm in circuit with said spring and said casing, said casing being also provided with a tumbler, by means of which the latch-bolt is operated, said tumbler being provided with arms which operate in opposite directions, and an insulated fork mounted in said casing, the sides of which are adapted to make contact with the arms of said tumbler, said fork being also in circuit.